

This series on good writing was compiled while Mead C. Killion was President of the American Auditory Society (AAS), the organization founded (by Aram Glorig and Dix Ward) on the belief that better communications among those of us dedicated to helping people hear better would be a good thing. If you agree strongly, please fill out the membership application on page 12. If you might be persuaded, please turn to page 11 for all the reasons we could think of that you should join us.

Good Writing

A Series of Articles

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Good Writing: Part I

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Scientific Writing Can Be Readable

by James Jerger

1962

Veterans Administration and Gallaudet College

Reprint: James Jerger's article "Scientific Writing can be Readable" *ASHA*, April 1962, pp 101-104. With Permission

Nowadays scientists have to write in three different styles; one for research proposals, one for progress reports, and one for the serious reporting of research in books and journals.

"Proposals" is a fairly stereotyped language system in which you must stress by any means at your disposal, how it is that one ever thought of this clever idea before in view of its far-reaching theoretical import, as well as its significant implications for imminent clinical practice and rehabilitation. The secret is long words, complicated subordinate clause structures, and good old-fashioned evasion.

In progress reports the problem is how to make it look as though you've been doing much more than you really have all these months. The secret is long sentences, the longer and more complicated the better. This gives the reader the impression that at least you have been thinking about these things pretty hard, while at the same time you are tiring him out so rapidly that he doesn't have the energy to go back over it carefully and see exactly what you did.

Both proposals and progress-report writing are specialized journalistic forms. They have evolved as the best methods for doing a particular job; that is, concealing the actual circumstances in a protective cloud cover of extensive language. The only criteria on which these two styles can be judged are whether you get the grant and whether it is renewed.

There is absolutely no reason why this writing style needs to carry over into the serious reporting of research findings. Here the criterion is whether or not you are getting your message across to the reader. The requirements for success

Authors who publish in our journal, *Ear & Hearing*, routinely use good writing. The purpose of this series is not so much to further increase the quality of writing in our journals (although reinforcements of virtue are always in order), as to provide information for those who should publish but can't because one or several of their teachers taught them how to write badly!

The James Jerger reprint that leads this series is one of the best articles on clear writing that I have seen. It first appeared more than 30 years ago, so it is reasonable to assume many readers have never seen it. Even those who remember the article will undoubtedly welcome the resurrection of an old friend.

Mead C. Killion, Ph.D.

President, American Auditory Society, 1995-1997

are quite different from the first two areas. In scientific reporting the object is to convey to the reader what you did, why you did it, and what you found. This objective is not always achieved in our Association Journals. I believe that four major problems can be identified. First, sentences are frequently much too long and complicated. Second, language is often painfully artificial. Third, we use the passive voice to excess in verb construction. And, finally, authors are most emphatically discouraged from using the sparkling gems of our language, personal pronouns.

Here is an example of what I mean by long, complicated sentences. This appeared in a recent issue of the *Journal of Speech and Hearing Research*:

"Concerning the motivational component it seems noteworthy to report that several teachers in three different schools for the deaf mentioned to the experimenter that their pupils, when they reach the age of starting in intermediate grades, show a lessening of interest and lack of progress in scholastic achievement."

Now this is really three different sentences all wrapped up in one. We can unravel it as follows:

- (1) Motivation could be a factor.
- (2) Several teachers in three different schools for the deaf mentioned this.
- (3) They said that their pupils showed less interest and lack of progress in scholastic achievement when they started the intermediate grades.

This example illustrates an important principle in how to make scientific writing readable. **Write short sentences. Use a new sentence for each new thought.** This sounds vaguely familiar doesn't it; something they told us in the ninth grade or thereabouts? Apparently it was not reinforced on the right schedule.

Here is another example from *JSHD*:

"Assessment of the child by the speech pathologist with his training and experience in the physiological and psychological aspects of speech often provides important leads indicating a more refined analysis of psychological variables is needed for a thorough understanding of the speech problems."

If you had trouble with this the first few times through it is because, again, there are three different ideas in the same sentence:

- (1) The speech pathologist has training and experience in the physiological and psychological aspects of speech.
- (2) By virtue of this training his assessment of the child often provides important leads.
- (3) These leads may indicate that thorough understanding of the speech problem requires a more refined analysis of psychological variables.

Long complicated sentences, however, are not nearly as serious a problem as artificiality. A second useful principle in making scientific writing readable is to **write it the way you would say it**. Consider, for example, this sentence from a recent issue of the *JSHR*:

"Because of the smallness of the group and the close proximity of its members, the distance variance among the subjects was not considered to be an important factor with respect to the test results."

This style of writing is difficult to read because it is not the kind of English we hear everyday. People just don't talk that way. If the author were telling you about this in person he would probably say something like this:

"All subjects were not exactly the same distance away. But the group was small and they were sitting fairly close together; so we didn't think that the slight differences would affect the results."

Here is another example from *JSHD*:

"Limitations imposed by the strata from which this sample was drawn preclude the use of the data as normative."

Now can you imagine anyone actually talking this way? Picture two fellows in the locker room. One says to the other, "Limitations imposed by my wife's attitude, preclude my participation in tonight's poker game." The lesson is this. Language that is patently artificial is difficult to read. If you want to make it easier, write the kind of language that people actually use when they talk to each other. Just to prove that no one is immune to this sort of thing, here is a sentence I wrote a few years ago:

"Recognizing the constraints necessarily imposed by the small sample sizes, the small number of frequencies, and the particular automatic audiometric instrumentation employed in this study, the following conclusions are offered with respect to automatic audiometric methods in which the subject traces his threshold for a fixed frequency over time by controlling the direction of rotation of a motor-driven attenuator."

That is almost bad enough to build a proposal around. It translates as follows:

"We realize that we haven't run very many subjects, and we haven't done too many frequencies, but here is what we found out about automatic audiometry. It only applies to fixed-frequency, Békésy-type tracings."

A third factor that tends to make scientific writing difficult to read is an almost religious dedication to the use of the passive-verb construction. Consider the following example from a recent issue of *JSHR*:

"However, if it can be demonstrated that children with articulation problems can learn a newly taught sound task as well as children considered to have normal articulation then it would appear justifiable to assume that present

differences in articulation are not a result of the present operation of certain physical and psychological factors.”

This sentence is a bit too long and involved to begin with, but notice how much we can improve it by just changing the verb structure:

“However, if children with articulation problems can learn a newly taught sound task as well as children considered to have normal articulation, then we can justifiably assume that present differences in articulation do not result from the present operation of certain physical and psychological variables.”

I had the good fortune to uncover a monumental string of passive constructions in a recent monograph supplement to *JSHD*.

“With the subject seated in full view of the recording equipment, a tape-recorded speech sample was obtained. First, the tape recorder was turned on and the subject was asked for identifying information such as name, age, level of education and marital status. He was then asked why he had come to college and what previous experience he had had in having his speech recorded. The main purpose of this interview was to accustom the subject to the experimental situation. After two or three minutes of conversation the recorder was turned off and instructions were given for the first speaking performance, the job task. The subject was instructed to perform this task by talking for three minutes or so about his future job or vocation. It was suggested that he tell about the vocation, why he chose it, and anything else about it that he wished to discuss. If the subject had not yet chosen a vocation he was asked to tell about jobs he had held in the past. He was allowed one minute to think about what to say. The recorder was then turned on and the subject was asked to begin speaking.”

There is nothing seriously wrong with a passage like this except that it makes insufferably dull reading. As an exercise, try your hand at brightening it up by changing passive constructions (e.g., “was obtained, was asked, was turned off, were given, etc.”) to active constructions wherever possible. You might begin something like this:

“The tester seated the subject in full view of the recording equipment, then obtained a speech sample in the following way, First he turned on the tape recorder and asked the subject for identifying information such as ... etc.”

Finally, and perhaps most importantly, nothing livens up dull material like *personal references*. Use them often. Especially, use personal pronouns like I, me, we, you, she, they, etc. Don’t use them to excess—the excessive repetition of anything makes dull reading—but don’t be afraid to use them when they are clearly necessary in order to say a thing naturally. Here is an example from the same *JSHD* monograph:

“For the reason just mentioned, the regression equation based on 100 samples of speech ... is not recommended for predicting a single speaker’s median rating of severity of stuttering.”

Now scientists make a big thing of precision in language, but here is a case where the circumlocution required to avoid the use of a personal pronoun actually degrades precision. The use of this regression equation is “not recommended.” Not recommended by whom? By ASHA? By a majority of experts in stuttering? By the author’s major professor? No, I think that what the author wanted to say was:

“For the reason just mentioned, I do not recommend the use of this regression equation for predicting a single speaker’s median rating.”

By using the personal pronoun the author makes this sentence not only more readable but more precise.

I will never understand how this compulsion to avoid personal pronouns at all costs in scientific writing ever got started. Scattering them about is one of the easiest ways to make dull prose come alive. Notice how the following sentence—impossibly long and involved by any standards—still sparkles with a personal touch. It is from Galileo’s description of the discovery of Jupiter’s satellites (3, p.59):

“On the 7th day of January in the present year, 1610, in the first hour of the following night, when I was viewing the constellations of the heavens through a telescope, the planet Jupiter presented itself to my view, and as I had prepared for myself a very excellent instrument, I noticed a circumstance which I had never been able to notice before, owing to want of power in my other telescope, namely that three little stars, small but very bright, were near the planet.”

At this point many of you are undoubtedly feeling that perhaps there is some point to what I have been saying for certain kinds of articles, but the reporting of really intricate, subtle, and significant research findings just has to be written in a dull way. Consider, then, this model of simplicity and clarity in scientific writing by Nobel Laureate Georg v. Békésy (1, p.371):

“When we compare research with animals to research carried out on man, we see that we are dealing with two quite different situations. With animals we can always start from the normal condition, whereas with man we must first make a diagnosis in order to determine the starting point. Most diseases have more than one symptom, and since the disease may have progressed in any one of several different ways, two cases will rarely have similar starting points. This simple fact indicates that, for effective investigation, interaction must take place between clinical and animal experimentation.”

Let's see if we can't take what we've learned so far and rewrite this in a manner suitable for an Association Journal. We can begin by eliminating the offensive personal pronouns, then make the sentences much longer, and finally change the phraseology so that it will impress rather than inform:

"Previous attempts to equate research endeavors concerned with physiological experimentation carried on in the laboratory on animal preparations with psychophysical and psychological behavior of the human organism inevitably suggest the existence of a fundamental multidimensionality which cannot be easily resolved or effectively reconciled under present circumstances.

In the case of animal preparations it is preeminently feasible to take as a point of departure the fact that the basic frame of reference encompasses an organism that is initially intact, whereas, in the case of human behavioral investigative techniques, factors intrinsic to the determination of the pre-experimental status of the organism manifestly dictate the necessity for assessment and evaluation of that organism's status with respect to diagnostic categorization. . . .etc., etc."

Well, we could go on and on like that. If you think this is stretching the point at all, consider the following excerpt from a recent issue of *JSHD*.

"Articulatory patterns of speech develop as one aspect of the psychophysical systems encompassing total growth and development of an individual in conjunction with maturation and learning. Articulation is dependent upon a continuous process of development from a simple and homogeneous medium to a highly complex, modified and differentiated level of growth. As a child matures, he must endeavor to make a fundamental adjustment to his intrinsic and extrinsic environments, regardless of what prospects they hold in store for him. Whether or not the child develops acceptable patterns of articulation depends upon numerous complex and multidimensional elements. In the final analysis, it is not practicable to relegate articulatory maturation to any one single variate of growth and development. Actually, competency in articulation seems to focus upon the extent to which all developmental propensities contribute to the eventuation of speech out of the psychophysical systems inherent in the human organism. . . ."

I would try to translate this for you, but I honestly do not understand what it means.

In summary we can all do four concrete things to improve our writing.

- 1) Write short sentences. Use a new sentence for each new thought.
- 2) Avoid artificiality and pompous embellishment. Write it the way you would say it.
- 3) Use active verb construction whenever possible. Avoid the passive voice.

- 4) Use personal pronouns when it is natural to do so.

There are many reasons why it would be to our advantage as a profession to improve the readability of our publications. One of the more important is the fact that you cannot communicate your research findings to other people unless you write about them in a way that allows other people to understand what you are talking about. And communication with other people is, after all, the reason for scientific publications.

Let us bring our unique professional talents to bear on our own communicative disorder.

Acknowledgment

I am indebted to my colleagues, Stanley Zerlin and Laszlo Stein. They contributed their own unique obfuscatory talents to the rewriting of the Békésy passage.

References

1. Békésy, G. V., Are surgical experiments on human subjects necessary? *Laryngoscope*, 71, 367-376, 1961.
2. Flesch, R., *The Art of Plain Talk*. New York: Harper and Bros., 1946.
3. Galilei, Galileo, *The Sidereal Messenger*, 1610. (quoted in Shapley, H., Rapport, S. and Wright, H., *A Treasury of Science*. New York: Harper and Bros., 1943).

Good Writing: Part II

AAS Bulletin, Vol. 21, #3, 1996, p. 9, 17

How do you become a good writer?

by

Mead C. Killion, Ph.D.

Find a good editor! Someone who, like a Békésy "enemy", will work tirelessly to find errors in your work and point them out to you. As the Nobel laureate of hearing science wrote:

"One of the most important features of scientific research is the detection and rectification of errors. ...One way of discovering errors is to repeat the same measurements by different methods.

"Another way of dealing with errors is to have friends who are willing to spend the time necessary to carry out a critical examination of the experimental design beforehand and the results after the experiments have been completed. An even better way is to have an enemy. An enemy is willing to devote a vast amount of time and brain power to ferreting out errors both large and small, and this without any compensation. The trouble is that really capable enemies are scarce; most of them are only ordinary. Another trouble with enemies is that they sometimes develop into friends and lose

a good deal of their zeal. It was in this way that the writer lost his three best enemies.” (Georg von Békésy, *Experiments in Hearing* pp 7-9, McGraw-Hill Book Company, 1960).

Assuming good basic skills, most writers can act as their own editors provided they leave enough time to put the piece away for a few weeks so that they can read it “cold.” It can be nothing short of amazing how many errors you catch — and how many sentences you can shorten or otherwise improve — if you read your manuscript a month after you put it aside.

If you are writing under deadline pressure, either your own or imposed from outside, finding a tolerant friend to go over your work is worth several writing courses. Tolerant of your writing, that is, not tolerant of bad writing.

My own writing has benefited enormously from the editing comments of Edgar Villchur. Some people have been reported to spend their lives unsuccessfully trying to get one letter-to-the-editor published in the *NY Times*. Villchur has the unusual distinction of having had the *NY Times* accept 20 of his¹. How does he do this? He has trained himself to go over a manuscript (including his own) looking for several things:

1. Typographical errors, of course.
2. Checking that the literal meaning of words and sentences is the same as the context meaning.
3. Trimming. Shortening. Cutting out repetition and superfluous words and phrases.
4. Clarity.

For example, Villchur would shorten item 3 above to:

3. Trimming. Shortening. Cutting out repetition.” The added punch in the shorter version is obvious. Repetitions usually are superfluous.

Strunck and White give a humorous example of item 2 in their book *Elements Of Style*: “Having eaten our lunch, the bus went on to Chicago.” Less humorous was the title of one published article, “Two Microphone Arrays.” The reader might reasonably assume this was an article on two different types of microphone array (endfire and broadside, for example), with an unidentified number of microphones in each array. The article discussed instead two-microphone arrays, i.e. microphone arrays where each array contained two microphones. Readers can usually decipher such writing with some effort, but it makes for early bedtimes.

By amusing coincidence, today’s (Jan 7, 1997) issue of the *NY Times* carried an article titled “Science Journal Seeks Plain English,” echoing Jim Jerger’s comments reprinted in the last *AAS Bulletin*. The *Times* article says: “NATURE, one of the world’s most prestigious scientific journals, has begun a campaign to purge arcane jargon from its pages and to make its sometimes opaque articles more accessible to nonspecialists.” Later on, the article continues; “In 1992, Dr. Donald P. Hayes, a sociologist at Cornell University, undertook an analysis of the intelligibility of scientific publications, and reached some conclusions that troubled journal

editors. He developed a scale of reading difficulty based on the frequency of unfamiliar or difficult words in a text. The system defined its zero point as the difficulty of international English-language newspapers, and ranged from least difficult, minus 59.1, (farm workers talking to dairy cows) to most difficult, 55.5 (a *Nature* article on the transhydrogenese reactions). ‘Since 1947,’ Dr. Hayes wrote, “Nature’s research articles have become harder to read in each successive decade.”

To paraphrase a popular statement, “If the hearing science writer isn’t part of the solution, they are part of the problem.”

Finally, don’t expect journal editors to fix your writing. They have a different focus. If you haven’t already done a pretty good job (for most of us this translates into getting a friend who is a good writer/editor to go over the manuscript as often as necessary to produce a readable document), the editor will become so bogged down trying to decipher your English that even a good experiment may appear valueless.

Remember, editors volunteer their time mostly out of a love of good science. Even if you paid them, they probably wouldn’t be willing to take the time to fix your sloppy writing. You need to find a willing friend. And do whatever it takes with that friend to produce a good result.

¹A set of Villchur’s letters-to-the-editor will be sent on request, if it is accompanied by a self-addressed envelope, to *Etymotic Research, 61 Martin Lane, Elk Grove Village, IL 60007*.

Good Writing: Part III

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More on Good Writing

by

Mead C. Killion, Ph.D.

How do you become a good writer? Better yet, how do you know when you are? Probably when colleagues tell you that your articles are particularly enjoyable to read. I have had that pleasure often enough over the last 60 or so articles, book chapters, application notes, and even patents, that I hope the following will be of interest.

In high school, I learned that the more obtuse I made an essay, and the greater the number of polysyllabic words I used, the more likely I was to get a good grade. This is consistent with the study of University of Chicago English professor Joseph Williams and Chicago State University English professor Rosemary Hake, who found that writing which was obtuse, nominative (no action verbs), and which substituted obscure

words for plain English nearly always earned better grades in both high school and college than clear, direct writing (Hirsley, 1977). Bad writing is taught.

In college, however, I was dismayed to find my best essays slashed to bits — returned with half or more of the words crossed out in red ink — by my Freshman English instructor Bob Harvey. Harvey had been a newspaper editor before coming to Wabash College, and had no patience for high school writing. Worse, my Freshman speech professor, Norward Brigance, returned my speech drafts with large sections laboriously taped over and retyped in plain English.

After college, Hugh Knowles and Elmer Carlson worked my papers over, again striving for clear, simple English. Hugh Knowles once told me: When you are writing for possible foreign readership, don't ask if it can be understood; ask if it can be misunderstood! Also, never use different words for variety if they mean the same thing. The non-native-English reader will spend time searching for the subtle differences you meant to convey by your word play.

My most important writing tutor, however, has been Edgar Villchur. As mentioned in previous remarks, Villchur has the unusual distinction of having had the *NY Times* accept 20 of his letters-to-the-editor. For several years, Villchur was an invited speaker at an Ecumenical Conference, Witness for Peace. His assigned topic? How can we write so well that we can have our concerns published in the *NY Times*? Some of his listeners subsequently succeeded.

Although he didn't mention it in the accompanying article, Villchur has written well over one hundred technical articles. He made his living that way for years. Villchur was also one of those selected (along with Einstein, Michelson, Maxwell, and Feynman) to have a chapter included in the Harvard University experimental physics textbooks. The criteria were not only those he describes (clarity and simplicity of expression), but also importance of the concepts expressed.

I asked Edgar Villchur to let us publish, in the *AAS Bulletin*, his recent comments on clear writing. He kindly consented (see accompanying article, "Clear Scientific Writing"). I trust you will enjoy them as much as I did.

ABOUT REJECTION

As an aside to those authors who may be discouraged by reviewer rejection, it may be of some consolation to know that even Villchur has had scientific writings rejected (sometimes by reviewers who could not write clearly or punctuate correctly, other times by editors with strong contrary beliefs).

Villchur is in honorable company. Albert Einstein stopped submitting papers to one physics journal because of consistently bad reviews. An author friend whose recent novel is now on the best sellers list, an extraordinary accomplishment for a first novel, told me that it was rejected by 35 publishers before one finally accepted it. (Satisfyingly enough, one of the publishers who rejected the first novel is eagerly pursuing his second novel.)

My colleagues and I had an important (we were told by

others) paper on the acoustics of small tubes rejected — without hope — two times by the *Journal of the Acoustical Society of America*. It was finally accepted on the third submission, nearly ten years later. With the third try, supporting letters from two physicists affirming that they were using our results on a regular basis — and felt our results were important — may have turned the tide.

So are editors the problem? Sometimes, but seldom. My experience teaches me that if an editor or reviewer didn't understand what I wrote, it needs rewriting: the reader probably won't understand it either. Rewrite it. Rewrite it, resubmit it, and if necessary try another journal. Consider trying ours, for example!

REFERENCE

Michael Hirsley: "Convoluting prose tangles teachers in web of words." *Chicago Tribune*, May 22, 1977.

Clear Scientific Writing

Edgar Villchur, Ph.D.

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The following article is not intended as a manual on scientific writing, but points out some common errors that create ambiguity of meaning.

Simplicity

Recently I read about a method of rating the performance of regulated human tasks. The method was to measure different kinds of error separately (relative to an ideal value of performance), and then to combine the results by integration. The description follows:

"A measure that is commonly used in human factors research... is error as the integrated deviation from the ideal value for each variable on a maneuver over time. This approach would require specification of the ideal value from which error is to be calculated, both at the time a maneuver is run and when the error is computed..."

Most people would have to read this passage more than once to understand it, and it is likely that many of the original readers didn't bother with a second attempt. The author could have said the same thing much more simply, as in this article two paragraphs back, and then added an equation if he wanted to express the idea mathematically. The unnecessarily complex language stands in the way of communication between the author and most readers.

When specialized terms are used — perhaps because no common terms are precise enough — it is especially important to use the terms correctly. I once reviewed a paper in which the author referred to ear canals as *meatus*' (an apostrophe indicating the plural). In my review I said I preferred the term "ear canals," but that if the author wanted to use a

Latin term it was important to use it correctly: the plural of “meatus” in English is either “meatus” or “meatuses,” and the general term “meatus” needed to be qualified as “auditory meatus” (Webster defines a meatus as any natural passage or duct in the body). Using specialized terms incorrectly makes it seem they are not intrinsic to the meaning and not part of the writer’s natural speech, but have been introduced for effect.

Simplicity in writing is not limited to uncomplicated subjects. Harvard University designed a series of experimental physics text books (1971) that included reprints of scientific articles by physicists such as Albert Einstein, A.A. Michelson, James Clerk Maxwell, and Richard Feynman. The articles were notable for their clarity and simplicity of expression, and Harvard had chosen them as suitable for high school students.

Literal Meaning of Sentences

One of the most important principles of clear scientific writing is that the literal meaning dictated by the words and grammatical construction must be unambiguous and the same as the intended meaning.

Often a reader can, after some study, ferret out what is being said in a carelessly written passage of scientific writing. But the writer’s expectation that everyone familiar with the subject will understand what is meant is no excuse for sloppy writing. Strunk and White (1979) gives this example of a badly constructed sentence:

“Being in a dilapidated condition, I was able to buy the house very cheap.”

While no one will think it is the buyer rather than the house that is in a dilapidated condition (at least after a moment’s reflection), the extra time it takes to reject the false meaning breaks up the clear flow of ideas.

Violation of the principle of keeping the literal and intended meaning the same is common: one such violation is to use pronouns like “this” or “it” without a clear identification of what is called the antecedent — what “this” or “it” represents. For example, the antecedent for the word “it” is not properly identified in the following sentence about an awkward suitor:

“Everytime he goes to her house he puts his foot in it.”

Pronouns such as “this” or “it” are commonly used in order to avoid repeating a noun, but it is better to repeat the noun than risk ambiguity in the identity of the antecedent.

It is necessary to guard against unintended possible meanings even when these alternate meanings are silly. One literal meaning of a sentence I have seen used, “The data were¹ age corrected,” is that the data had been corrected for their age. It would have been better to say that corrections for the subjects’ ages were applied to the data. The reader would choose the sensible meaning in any case, but the need to make a choice interrupts the text.

I came across an example of ambiguous meaning in an article entitled “Two Microphone Arrays.” The article was a description of the kind of arrays that use two microphones, but the title could also have meant a study of two arrays, each

with an unspecified number of microphones. A hyphen between “Two” and “Microphone” would have made the meaning unambiguous. These two words used together as an adjective become a temporary compound; the hyphen ties “two” to “microphone” rather than “arrays.” (Evans and Evans (1957) illustrates the use of temporary compounds with the expression “a light-yellow scarf”; without the hyphen the reference could be to a yellow scarf that is light in weight.)

Mathematical Treatment

The use of mathematical analyses and equations may be useful and/or necessary, but sometimes it is merely a technical flourish meant to impress the reader. When mathematics is used unnecessarily it is usually a reflection of the writer’s uncertainty, either of the meaning or the importance of what he or she is saying. Superfluous equations sometimes serve as mathematical masking.

When mathematical treatment is necessary, a clear statement in simple language of what the equation says in mathematical symbols is usually possible and is a great help to the reader’s understanding. Often the text that introduces an equation, such as “The following equation defines the relation between loudness and intensity in normal listeners,” leaves out the conclusion that is to be drawn from the equation. But if the introductory statement includes a general summary of what the equation says — for example, “It shows that increases of intensity at high levels produce a greater increase in loudness than equal decibel increases of intensity at low levels” — the reader is prepared for the more detailed teaching of the equation.

A verbal summary of what is being demonstrated nonverbally is equally useful for graphs. The caption for a graph illustrating the equation referred to above might be limited to a description such as: “Fig. 3 shows the relation between loudness and intensity.” That description fails to state the main point demonstrated in the graph, and doesn’t help the reader get an intuitive understanding of the graph’s meaning. Weaver (1949) included this sentence in his description of a graph of loudness vs intensity: “A rise of 1 dB in a strong tone adds more to its loudness than a similar rise in a weak tone.”

Some graphs plot the relationship among three elements. For example, we might want to show how the relation between loudness and intensity is affected by different amounts of the hearing pathology called recruitment. The direct method of showing this in a graph would be to plot a family of curves of loudness vs intensity, each curve for a different amount of recruitment². But an effective way to increase the difficulty of understanding this relationship would be to represent the ratio between loudness and intensity (which predicts the amount of recruitment) on one axis of the graph, and the amount of recruitment on the other axis. Such a graph would contain the same information as the family of curves but would be far more difficult to decipher, and for that reason some writers might consider it a more impressive display.

Mathematics can provide the reader with a fuller understanding of the subject, and it can facilitate checking experimental results. It should neither be avoided nor used unnecessarily.

General Suggestions

Examine and be guided by the style and format of articles in the publication to which you are submitting.

Consult American National Standard ANSI Z39.16-1979, "Preparation of Scientific Papers for Written or Oral Presentation." Among the things you will learn from this Standard are that articles should have a clear and logical organization, that the writing style should take into consideration less specialized readers, avoiding "jargon, abbreviations, and shortcut thinking intelligible only to a few," and that the manuscript should be double spaced and on one side of the paper. Submitting a manuscript that is single spaced and on both sides of the paper is a discourtesy to editors and reviewers, and starts the manuscript out with two strikes against it.

Keep Evans and Evans (listed in the references of this article) handy as an authority on the accurate, unambiguous and unpretentious use of English.

Writers are typically immersed in their subject and know the intended meaning of what they have written, so they often become desensitized to ambiguous and unclear passages. Put the article away for a while and then try to read it for the literal meaning of the language, as though the subject were new to you. Sometimes errors and unclear expressions will seem to leap out from the page.

Summary

Friedrich Engels wrote: "What has been clearly thought out can also be said clearly and without circumlocution. The philosophical evils which disfigure the writings of the erudite seem to aim more at concealing thoughts than at revealing them." In preparing an article, writers should first make sure they themselves understand fully what they are writing, and then work for maximum clarity and simplicity of expression, avoiding unnecessary technical jargon. Jerger (1962) put it this way: write in the style you use when you talk.

Footnotes

¹Evans and Evans (1957) says data is usually treated as a singular in the social sciences and as a plural in the physical sciences, but that either is correct. Fowler (1965) frowns on using data as a singular, but says it is often used that way in the U.S. Both authorities point out that Latin plurals sometimes become singular English words (e.g. agenda, stamina).

²The amount of recruitment is the parameter, or independent variable, of this family of curves; it is the variable whose values represented in the graph are chosen beforehand. The common use of "parameter" to mean any defining characteristic or element is a careless and improper expropriation of a mathematical term that has a precise meaning.

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Good Writing: Part IV

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Good Writing:

The Lettered Teachings of
Professor W. Dixon Ward

by

Mead C. Killion, Ph.D.

W. Dixon Ward was a co-founder (with Aram Glorig) of the American Auditory Society, and was President of the Society in 1976. He helped shape the mission of the AAS: dissemination of scientific information across the many professions involved in hearing. He lived a similar mission, gaining a reputation in psychoacoustics, (especially musical perception), physiological acoustics (especially noise damage to the auditory system), and as a teacher. Last month, the Acoustical Society of America included a Dix Ward Memorial session in its scientific program.

Not as widely known, perhaps, Dix cheerfully spent a substantial amount of energy pointing out examples of bad writing as they occurred around him. Arlene Carney, fellow professor in the Communications Disorders Department at the University of Minnesota where Dix taught, presented the first paper at the ASA memorial session. Her paper was a wonderful distillation of the Ward letters on writing (and almost everything else).

Both because Dix was one of our founding fathers and because his comments were often exquisite in teaching with cutting humor, it seemed appropriate to include some of Dix's letters in the continuing series on good writing that has been appearing in the *AAS Bulletin*. Arlene Carney was kind

enough to provide samples of Dix's letters on writing.

Dix's own technical writing was a delightful combination of utmost clarity and dry humor. My favorite example, from his early research on "perfect pitch," is reprinted on a following page with permission of the Acoustical Society of America. Short examples of Dix's letters on writing are interspersed.

Absolute Pitch

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Note: This is part of an article in support of the "Good Writing," series being written by Mead Killion, AAS President and published here in the *Bulletin of the American Auditory Society*.

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When the director of a good chorus wants to begin an *a capella* number, he usually has someone strike the key note on the piano, or perhaps blows a pitch pipe himself. Only one tone is generally given, and, yet, when the first chord is sounded, as many as eight or more different pitches are being sung—and sung as accurately as if each voice section had been given its individual starting note. Somehow, each of the first tenors, knowing that the reference note is, say, A4 and that the first tenor part begins on D5, is able to "go up a fourth" from the reference pitch, without making a sound. Similarly, the second altos come in unerringly on F4, having "gone down a major third" in pitch, and so on. Each of these individuals apparently has an internal scale of relative pitch, a movable conceptual grid or template, if you will, that specifies the pitch relations between the notes of our Western scale. The reference note simply serves to tie one point on this grid to the physical world. With this anchor, the individual knows

what *every* note in the scale should sound like. He can therefore judge with great confidence whether notes heard later are higher or lower in pitch than they should be.

Tests generally indicate that his confidence is well-founded, that he can indeed tell when the frequency of a second tone deviates as little as 1% from his expectations, based on the frequency of a first tone and a knowledge of what the musical interval should be, although these judgments may not be nearly as accurate as they are consistent. For example, the frequency that an individual judges with great consistency to be "an octave above 1000 cycles per second (cps)" may not be the 2000 cps demanded by theory. Instead, it may be 2100 cps for one particular ear, 2060 for another, etc. Each ear has its own peculiarities of tuning, it would appear.

Nevertheless, the ability to make such consistent judgments of relative pitch is, in my opinion, quite amazing. Certainly, no counterpart exists in any other sensory modality. (It is true that most people can be induced to apply ordinary numbers to all sorts of sensation, and that "scales of subjective magnitude" can be constructed from these judgments. However, the variability—both intra- and inter-individual—of judgments such as these is several orders of magnitude larger than those associated with the relative musical pitch scale.) The closest analogy to relative pitch would be application of the relation "complementary to" in visual hue. Given a certain shade of red, there exists a green that is complementary to this particular red. But are there people who can, by merely looking alternately at this red and at a series of greens, pick out the best complementary? Although no elaborate experimentation has been done along these lines, I would not expect that either the consistency or accuracy of such judgments would be nearly as high as those involved in relative pitch.

However, despite its uniqueness in sensory psychology, the ability to make relative pitch judgments generates nowhere near as much fuss as the phenomenon known as "absolute pitch." If our chorus includes someone who "pos-

sesses" this ability, the director need only nod to this person, whereupon he or she will hum the desired reference tone without recourse to instrumental aids, and the rest of the chorus can get their starting pitch from this tone.

A suggested definition of absolute pitch (AP), often called "perfect pitch" by musicians, is as follows: the ability to identify the frequency or musical name of a specific tone or, conversely, the ability to adjust the frequency of a variable tone to some designated frequency, frequency level, or pitch, without comparing the tone to any objective reference tone, i.e., without using relative pitch. Thus both the identification and production of tones are included. In our example, the voice of the singer would be the "variable tone" of the definition. It is as if such people have a fixed, rather than movable, internal pitch template for judging incoming sounds. Looking at it in a slightly different manner, one might infer that in AP judgments the pitch of the tone in question, say D4, is compared with all previous experience with tones that were called D4 and with adjacent notes (C#4, D#4), rather than with the immediately preceding stimulus.

Now, this type of behavior is the sort of thing that one finds in all sensory modalities, in contrast to the uniqueness of relative-pitch judgments. You do not need a whiff of ammonia as an anchor in order to identify attar of roses or cooking popcorn, nor a sip of ocean water to identify maple syrup. If you step on a thumbtack, it is not necessary to inspect each toe to determine where the tack is. In all these cases, the stimulation is identified (either correctly or incorrectly) on an absolute basis, that is, in reference to other stimuli long since past. The same holds for identification of a face or a voice on the basis of a single glimpse or a few words. Absolute judgments are clearly the rule, not the exception.

Nevertheless, many musicians regard AP with awe, if not reverence, as if it indicates that its owner is one of the elite in the musical world. And possessors, being human, enjoy this and naturally do little to destroy the impression.