

Improve Scientific Writing and Avoid Perishing

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ABSTRACT.—The purpose of scientific writing is to impart thoughts or ideas and their bases and implications in such a manner that a reading audience, with at least a moderate knowledge of science, can understand the material presented within a paper. This carries the necessity of using words in a manner that clearly impart the intended meaning of the author and not getting off the subject as reflected in the title. Also, the goal of scientific writing is to produce a manuscript written from the perspective of strength, rather than weakness. I discuss appropriate formation of titles such that the intended audience can find the title through bibliographic sources. Also included, to aid in the writing of scientific manuscripts, are discussions of words or sentences with unintended connotations, misuse of words, double entendres, slang, contrived acronyms, jargon, dangles or orphaned clauses and superfluous words. Finally, remember that the object of the art of scientific writing is to communicate in the most concise and precise manner possible, it is not to paint pretty word pictures.

INTRODUCTION

This discussion is my concept of the way that a scientific paper should or should not be written. It is not intended to criticize, but to improve precision and enhance communication. Not everyone will agree with me, but those who follow these suggestions likely will have fewer rejections and do less revising. In this era of “publish or perish,” it is imperative to produce manuscripts based on quality research, but even the best research may be lost to science if the scientific community is unable to understand the text in which it is presented. Furthermore, the goal of scientific writing is to produce a manuscript written from the perspective of strength, rather than weakness. Consequently, appropriate word usage, syntax and punctuation are imperative.

TITLES

Many people, when asked what is the most critical or far-reaching part of a scientific paper, would answer: the results or conclusions drawn from the research conducted. I beg to differ. The single most critical item in any scientific paper is—the title. Hundreds, if not thousands, of people will read a title when searching for information on a particular topic in the various bibliographic services on the internet or in libraries. And, a smaller number of people will read a title in the Literature Cited sections of papers published in journals. So, unless readers can understand the meaning of the title, the paper will never be read. Thus, for the intended audience to be reached, clarity of intended meaning and proper order of words used in a title should be of paramount concern to authors. Furthermore, everything presented in a scientific paper must in some manner relate back to the title. If it does not, then the title not only is inappropriate but the scientific paper will be buried in oblivion, a fate that no author desires. The ultimate goal of every author is for many people to read their published paper and have it of such a quality that it is cited often in papers by other authors.

Titles should be composed of the fewest possible words that **adequately** describe the contents of the paper. This does not mean the fewest possible number of words—titles can be too short as well as too long. An example of too short a title is: “Predatory animal

studies.” This title tells the reader only that predators were somehow involved in the conducted research. Titles should tell the reader ‘what,’ ‘where,’ ‘when’ and ‘on what species or group’ (if relevant) the research was conducted. Consequently, titles should form a single coherent concept actually related to the content of the paper: not a sentence, brief abstract, subtitle, hanging statement or, worst of all, a question. Also to be considered are the unintended meanings created by poor word-order and “watch-the-paw” tricks.

Sentences.—The primary problem with sentences for titles is they create dogma, for example: “Shrews (Soricomorpha: Soricidae) form an important component of ecosystems.” As any scientist should know, knowledge in science is ever evolving, consequently what is considered true today, probably will be questioned tomorrow, and may be rejected at some point in the future. Second, consider the words ‘important’ or ‘importance.’ Something simply cannot be ‘important’ without a reason, and usually it is the **reason** that is of interest to the reader. Also, to whom are the shrews ‘important?’ A better title would be: “Shrews (Soricomorpha: Soricidae) as a component of ecosystems.”

For another example, think about the title: “Dandelions as an ‘important’ item in the diet of cottontails.” Are dandelions ‘important’ because more cottontails eat them? Are they ‘important’ because cottontails eat more of them? Are they ‘important’ because they provide some nutritional requirement of cottontails not available in other plants?

Consider the title “Pollinator importance and temporal variation in a population of *Phlox divaricata* (Polemoniaceae)” published in *The American Midland Naturalist*. A pollinator can contribute to, aid in, expedite or promote something, but a pollinator will never be ‘important’ in and of itself. Also, what exactly do the authors mean by ‘temporal variation.’ Possibilities include: different times during which pollinators are active, seasonal or diurnal variation in occurrence or numbers of *P. divaricata* present in a particular habitat, changes occurring within a population of *P. divaricata* over a 24-h time period, among many others. A more appropriate title would be: “Contribution of pollinators to reproductive success of a population of *Phlox divaricata* (Polemoniaceae).”

Brief abstract.—Consider the title: “The role of rabbits in sylvatic plague epidemiology, with special attention to human cases in New Mexico and use of the fluorescent antibody technique for detection of *Pasteurella pestis* in field specimens” published in *Zoonoses Research*. A 32-word title is totally unreasonable. The authors of the paper should have used a title like “The role of rabbits in sylvatic plague epidemiology” (8 words) or “Identification of *Pasteurella pestis* in rabbits by the fluorescent antibody technique” (11 words) depending on which aspect of their research the authors wished to emphasize.

Subtitles.—Consider the title: “Phylogenetic studies of the rodent family Gerbillidae: I. Chromosomal evolution in the southern African complex.” What happens if number II is never published? I know of a series in which 1, 2 and 4 were published, but 3 was rejected. This means that the authors will forever be asked what happened to number 3. Also, the first part is too general and imparts little information to readers.

Hanging titles.—The title “*Sylvilagus nuttallii*: a semiarboreal lagomorph” published in the *Journal of Mammalogy* is a good example. Just how is a computerized ‘Key Word’ finder for a bibliographic service supposed to determine how to file this title such that the intended audience would ever have a chance of finding the paper? A useful version of the title would have been: “Tree-climbing behavior by mountain cottontails (*Sylvilagus nuttallii*).” Authors use hanging titles to be dramatic; however, authors should keep in mind that readers find them terribly annoying and generally unintelligible.

Questions.—Why is a title written in the form of a question the worst form of title? The answer is simple. The entire manuscript can be stated as a single word: “Yes.” or “No.” (plus literature cited, tables and figures, of course)! Consider the following example: “Evaluating

intraspecific 'network' construction methods using simulated sequence data: do existing algorithms outperform the global maximum parsimony approach?" published in *Systematic Zoology*. Not only does this title tell the reader little, if anything, about what the paper is about, but how would a computerized 'Key Word' finder file this title? If you were searching a bibliographic service, I doubt this title would ever appear no matter what key words were used. In terms of bibliographic services, this is a lost paper never to be heard of again.

Poor word-order.—Consider the title: "Unusual mortality in the depleted Cook Inlet beluga (*Delphinapterus leucas*) population" published in *Northwestern Naturalist*. This title actually means that something in Cook Inlet (wherever that is located) has been depleted. Also, the title includes the idea that something that normally does not kill belugas is now killing them. What the authors actually intended to state was: "Unusual mortality levels in the beluga (*Delphinapterus leucas*) population of Cook Inlet, Alaska."

Further, consider the example: "Observations on the fleas (Siphonaptera) of some small mammals in northwestern Illinois" published in *The American Midland Naturalist*. A reader would have the impression that the author had live fleas in a container of some sort and sat watching their behavior. A better title would have been: "Prevalence and occurrence of fleas (Siphonaptera) on some small mammals in northwestern Illinois."

Also, the use of freight-train wording absolutely should be avoided, e.g., "sheep red blood cells," "current breeding evidence" or "mean total small mammal catch per unit effort," in which adjective and noun modifiers are overused. This is a commonly used system of compounding nouns and adjectives as a shorthand means of communicating with colleagues that actually produces nothing more than incomprehensible jargon. Does "current breeding evidence" mean 'evidence of current breeding' or 'current evidence of breeding?' There could be a difference. A good rule is to put the precise subject first for emphasis and to use appropriate prepositions to indicate relationships. Also, appropriate use of hyphens to indicate which adjective or noun modifier is modifying which noun easily can solve any remaining misunderstandings.

Watch-the-paw tricks.—Many years ago I had a Springer Spaniel named Sam who was an expert at lulling me into a false sense of security that he was going to do only what he was supposed to do. Then, when my attention was focused on something else, he did whatever he pleased. Many authors do the same thing by having a title on one subject, but by the end of the Introduction they have reached an entirely different subject. The subject of the title is never again touched upon in the entire manuscript. After you drift off the title, you might as well be writing about Aunt Bessie's lumbago and the flea population on your dog Rover, as you have lost your readers and likely will not get them back again.

So, after discussing what not to do, what thoughts should be kept in mind when forming a title? A title should be short (10–12 words), specific and informative. It should include key words that will aid in indexing. Irrelevant words should be eliminated (e.g., "A study of," "Investigations of," "Observations on"). Do not create strings of modifiers that become incomprehensible—even if an editor or reviewer insists. Remember, it is your name on the byline, not the editor's or reviewer's names. Avoid "the" and other phraseology that might be construed to mean **ALL** aspects were studied or **ALL** species were studied. Finally, avoid abbreviations in titles, especially contrived acronyms and jargon.

TEXT

The purpose of scientific writing is to impart thoughts or ideas and their bases and implications in such a manner that a reading audience, with at least a moderate knowledge of science, can understand the material presented within a paper. This carries the necessity

of using words in a manner that clearly impart the intended meaning of the author(s) and not getting off the subject as reflected in the title. Thus, words or sentences with unintended connotations, misuse of words, double entendres, slang, contrived acronyms, jargon, dangles or orphaned clauses and superfluous words have no place in scientific writing. Also, proper use of word tense, number and voice is imperative. When writing a manuscript, always remember that Webster's Third New International Dictionary, Unabridged is considered the final authority on the meanings and usages of words in the English language.

Placement of modifiers.—Writing is stronger when split compound verbs (except with negatives) are avoided. Use "plots were monitored continuously" rather than "plots were continuously monitored." Too much emphasis is placed on the adverb. Avoid unnecessary split infinitives. Use "to examine carefully" rather than "to carefully examine." Again, too much emphasis is placed on the adverb. And, always use infinitives rather than gerunds. "To go is easier than to stay" rather than "Going is easier than staying." Remember, word usage and order, syntax and punctuation are different in scientific writing than speaking. When speaking it is always possible for the listener to have a point clarified; however, a reader has only what is printed on a page. Also to be considered is the need for proper and judicious use of punctuation (*i.e.*, commas, semicolons, colons, hyphens). The present trend is toward less punctuation (particularly fewer commas), but such requires careful writing without misplaced or dangling elements.

Get-ready sentences.—Many times in Introduction, Results or Discussion sections of papers, authors start a paragraph with a sentence that merely states what the author is going to tell the reader in the paragraph. This is called a "Topic Sentence" or a "Get-Ready Sentence" that actually only serves as filler in a manuscript. Such sentences may be appropriate literary style, but are too expensive for science writing. Further, it may be considered a delay tactic in writing while the author is trying to ascertain what to report to readers. There is no need to tell readers what they will read. Simply discuss the subject and analyses of the paper—as reflected in the title. Consider a paper with the title: "Sexual segregation in southern mule deer." The introduction began with the sentence (literature citations omitted): "The role of sexual dimorphism in niche separation has been investigated for birds, fish, and plants." An obvious question to ask is: "What does this have to do with mule deer?" Also, based on the title, the paper has nothing to do with sexual dimorphism or niche separation.

Also is the problem of some authors who write about tables and figures in the text. Examples would be, "Table 1 contains the data collected on habitat characteristics" or "Figure 3 illustrates the change in population levels from 1900–2000." Tables and figures should never be subjects of sentences. They should be used only as support, for or against, statements, contentions or hypotheses stated in the manuscript. Also, the text should be about the subject matter; do not use names of authors as the subject of sentences. Furthermore, avoid including great quantities of data and expecting readers to synthesize and interpret the information in the manner intended.

Unintended connotations.—Some words, such as 'mean' can impart a different meaning than intended if the writer is not careful. For example, "Mean deer lengths . . ." Are these longer than docile deer lengths? Try "Mean lengths of deer . . ." Be careful of 'average' for the same reason. Exceptional deer may not be longer than average deer. Another commonly misused word is 'since.' It has a time connotation, *i.e.*, from some time in the past to the present. Thus, for clarity, do not use 'since' as a synonym for 'because' or 'as.'

In morphometric and ecological studies commonly misused words are 'taken' and 'made.' Examples are: "Bilateral measurements . . . were 'taken' on both sides and averaged . . .," "Five dimensions were 'made' from each tree [or stream, prairie]," or "Measurements were

'taken' from 25 skulls." Dimensions, characters or features can be recorded or described, but they can never be extracted or formulated.

Misuse of words.—Certainly, the word 'using' is responsible for more ludicrous assertions in the literature than any other. Consider the example "Cottontails were caught 'using' live traps." Although cottontails may be caught in live traps, they do not use them. Try the prepositions 'in' or 'with,' or the phrase 'by use of' to avoid ambiguous meanings (*i.e.*, dangling or orphaned clauses). Think of the title: "Using a fiberoptic bronchoscope, dogs were immunized with sheep red blood cells." This title actually states that the dogs used the fiberoptic bronchoscope. What the authors intended to state was: "Dogs were immunized with sheep red-blood cells inserted through a fiberoptic bronchoscope."

Think of the statements: "Cottontails 'prefer' brushy habitats" or "The habitat 'preference' of mule deer was investigated." Likely what was intended was: "Brushy habitats support more cottontails" and "The dispersion of a mule deer population in relation to vegetation was investigated." Avoid use of 'prefer' or 'preference' when implications of cognitive ability in animals are not desired or not relevant. Always be sure to use correct word opposites: less than/greater than, lower/higher, fewer/more than, thin/thick, narrow/wide. Many times authors mix these pairings (*e.g.*, less than/higher). Not only is the mixing unacceptable in scientific writing, but it can create confusion. Additional examples of commonly misused words are provided in Appendix I.

Double entendres.—The sentence "Without human intervention to reduce the concentration of CH₄, the 2 million people along the Lake Kivu shoreline may suffer a catastrophic gas release" appeared in a recent issue of *Science*. The sentence should have been written: "Without human intervention to reduce the concentration of CH₄ in Lake Kivu, thus averting the release of lethal quantities of the gas, 2 million people living along its shoreline will suffer an enormous loss of life." Another example in the same issue of *Science* is: "Geneticists . . . analyzed 3 decades of records from the Fourth People's Hospital, the only psychiatric hospital in the Wuhu region of eastern China, which was hit hard by the famine." Was it the Fourth People's Hospital or the Wuhu region of eastern China that was 'hit hard' by the famine? Either meaning is possible. Double entendres are an example where reading a manuscript aloud probably would alert an author to the possible double meanings of the sentences, thus allowing the opportunity to correct them.

Slang or Colloquialisms are expressions considered more appropriate to familiar conversation than to formal speech or science writing; they belong to local or regional dialects. Thus, their use in scientific writing results from lazy thinking and a wish to avoid consulting a Thesaurus for the correct term. These include expressions like: "On the one hand . . .," "On the other hand . . .," ". . . studies that are carried out . . .," ". . . which side of the balance a bat falls on . . .," "as a matter of fact" and "It should be mentioned [noted, pointed out, emphasized] . . ."

Another commonly used slang term is "on average." What would "off average" mean? It is better to write "The average length of . . . was greater" or "The distance between traps averaged 1.5 m greater on the new grid."

Contrived acronyms are acronyms that lazy authors use to avoid having to write out the names of study or collection areas, dimensions examined, measurements recorded, laboratory techniques and names of organisms, among others. Apparently, many writers believe that use of contrived acronyms will greatly shorten a manuscript making it more acceptable to editors. Even if some editors find them acceptable, it is the readers who suffer. What contrived acronyms actually do is make reading a paper cumbersome and particularly annoying. Some published papers contain so many contrived acronyms that the reader is forced to refer back to earlier sections of the paper repeatedly to determine the meanings of

sentences—this is unacceptable scientific writing. Consider the sentence: “A total of 170 1-m² quadrats from 14 Mbeds yielded 3621 mussels” published in *The American Midland Naturalist*. Mbeds stands for ‘major beds.’ The contrived acronym saved no space in the sentence, but it added confusion.

Jargon.—Every word is a good word when it is used in an established meaning available to all. Every term is a good term if its meaning can be derived from the definition of the words from which it is formed. However, terminology created to serve as a short-hand means of communicating with coworkers (e.g., “group tree harvest”; “400 head cow-calf year around”) or others within a select group is **jargon**. I contend that jargon, particularly undefined jargon, has no place in scientific writing. Contrary to what you might think, I do not wish to prevent normal evolution of the language, but clarity and precision in communication should be the greatest concern of any author or editor. If it is absolutely necessary to coin new terms, then they must be defined clearly and precisely in text at first usage. Furthermore, if words are used in other than their standard dictionary meaning, they also need to be defined clearly and precisely in text. Consider the example: ‘placental scars.’ Almost all wildlife biologists know what ‘placental scars’ are, but I will not use the term in a manuscript that I publish because the special meaning of the jargon cannot be derived from the dictionary meaning of ‘placenta’ and ‘scars.’ The proper term is ‘pigmented sites of implantation.’ Think of the poor foreign researcher whose first language is not English who looks up ‘placenta’ and ‘scars’ in Webster’s Third New International Dictionary, Unabridged—and still cannot decipher what is meant. Lastly, consider the example: “Though these dens were some of the first discovered and logged during the study . . .” The word ‘logged’ has a variety of meanings including *cutting down* or *writing down*. The word ‘recorded’ or ‘noted’ should have been used instead.

Danglers or orphaned clauses.—These are words or phrases that modify something implied, but not stated in a sentence. The sentence “While browsing on a shrub, a deer was stalked by a cougar” implies that the cougar was browsing AND stalking at the same time. What was intended was: “While a deer was browsing on a shrub, it was stalked by a cougar.” Other examples are: “A large mass of literature has accumulated on ground squirrel burrows,” and “How many animals were tested, broken down by sex?” [rewritten from Day (1979:114–115, *How to write and publish a scientific paper*)], “Mice were caught using live traps,” and “Habitat utilization of bighorn sheep.” So, what is the best method of avoiding danglers or orphaned phrases? Always read sentences aloud while thinking about what **actually** was written.

Superfluous words.—These are words that act only as filler, add nothing to the meaning of sentences, and sometimes unintentionally change the meaning of sentences. Consider the sentences: “A total of six sampling stations were [*sic*] created in salt water pools . . .” and “In order to compare differences between sites . . .” published in *The American Midland Naturalist*. The same meaning would occur if the sentences read as: “Six sampling stations were created in salt water pools . . .” and “To compare differences between sites . . .” The words “A total of” and “In order to” add nothing to the meanings of the sentences. An example of an unintentional change in meaning would be the sentence “A total of 24 species was identified with richness ranging from . . .” Not only does it contain the superfluous ‘A total of,’ but by including those words the meaning was changed from ‘richness’ referring to ‘24 species’ to ‘richness’ referring to ‘total.’ Additional examples of superfluous words are provided in Appendix I.

Tense.—Use of the simple past, present, or future tense is always recommended. However, do not change tense within paragraphs. Also, avoid use of the emphatic mood (use “When they occurred . . .” not “When they ‘did’ occur. . .”) and the passive voice (use “Skunks produce musk” not “Musk was produced by skunks”), and be careful to use the subjunctive (use “If the

bait 'were' fresh, it would attract animals")—it takes a plural verb. Remember, scientific names at all taxonomic levels take singular verbs. Lastly, collective nouns take singular verbs when the group is regarded as a unit, but plural verbs when the individuals of the group are regarded separately. Good examples would be: "One thousand shrews 'is' an adequate sample; however, fewer than 500 shrews 'were' trapped" or "To the mixture, 10 g 'was' added."

Probably, the most common misuse of word tense is when authors refer to an area where a study was conducted. Consider the examples: "... the Rockefeller Native Prairie is a 4.0-ha remnant of mesic prairie that supports more than 165 native plant species," "The small prairie is surrounded by dense woody vegetation ...", or "The Little River estuary ... consists of 1.54 km² of *Spartina patens*-dominated high marsh ..." published in *The American Midland Naturalist*. If volcanic eruptions, hurricanes, fires, floods and ecological succession have taught scientists anything, it is that environments, including study areas, can be referred to in the present tense only when standing in the study area. Ecosystems are dynamic! So, refer to characteristics of study areas as they were when the study was conducted—always in the past tense.

Number.—This refers to whether a word is singular (1 item) or plural (more than 1 item). Within a sentence, never change number as this will create confusion. I am sure that the most misused and misunderstood word, relative to number, is 'data.' Singular, you would refer to a 'datum.' The word 'data' is a plural noun that agrees with a plural verb or pronoun. Examples would be: "These data ..." or "Data were ..." "This data ..." or "Data was ...," used so commonly by the media, are wrong and when used with an active verb produce a ludicrous image, for example, "The data show ..." Data may be interpreted by an investigator or the investigator may draw inferences from data, but data never show anything. Also, data do not have size, so avoid 'too little data' to describe inadequate samples, try 'too few data.' Years ago, an anonymous reviewer of a manuscript in which the author kept using the word 'data' with singular verbs, finally just wrote the following poem in a margin of the manuscript:

I never saw a little data,
I hope I never see some,
For they may be so small,
as to appear a single datum.

Although the hapless author was quite upset to be the recipient of this poem, appropriate modifiers were applied in the published paper.

Active/passive voice.—Consider the sentence: "*It was concluded* that humans ate more berries than bears" written in **passive voice**. Reader's of this sentence might think that the authors are attempting to reduce their accountability for the results of their research. When scientists produce a manuscript describing their research results they need to be willing to take responsibility for the content of the manuscript. Thus, a stronger sentence in **active voice** is: "*We (or I) concluded* that humans ate more berries than bears." Sentences are strengthened by use of the **active voice** in which the writer *asserts that the person or thing represented by the grammatical subject performs the action represented by the verb*. Although popular in prose writing, scientific writing is weakened by use of **passive voice** because it *asserts that the person or thing represented by the grammatical subject is subjected to or affected by the action represented by the verb*.

CONCLUSIONS

When all the analyses and writing are done, and a 'finished' manuscript is in the author's hands, if at all possible, it should be set aside for at least 1 wk (a month is better) while other

research is being conducted. This allows time for the author's mind to 'forget' what was implied in the writing of the set-aside manuscript. Then, read the manuscript aloud and carefully when not in a hurry. Many times authors will find statements that suddenly make no sense or paragraphs that do not flow properly or as intended. Thus, an opportunity is presented that allows the author to refine the writing before editors and reviewers demolish a manuscript for poor and unclear writing. The last thing any author should do before sending the manuscript to a managing editor of a journal for consideration for publication is to read the manuscript aloud to a critical listener. It is truly amazing how many strange sentence structures, typographical errors, punctuation errors and omissions are discovered by such a simple process. Finally, remember that the object of the art of scientific writing is to communicate in the most concise and precise manner possible, it is not to paint pretty word pictures.

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APPENDIX I

Following is a selection of superfluous and often misused words in scientific writing not included in text. A flyer distributed by the Iowa State University Experiment Station on word usage served as a starting point.

ABOVE.—"... the above method" or "as mentioned above." A term often used in reference to something preceeding, but not necessarily 'above'; a loose reference, convenient for writers, but not for readers. Also, remember, if something was mentioned previously, to do so again is redundant. Compare with 'below.'

ACCURATE.—"... an accurate estimate" 'Accurate' implies *complete freedom from error or absolute exactness*. An 'estimate' is an approximation. Try "... a reliable estimate"

AFFECT/EFFECT.—'Affect' is a verb that means *to influence*. 'Effect,' as a verb, means *to bring about*; as a noun, it means *result*.

ALICQUOT.—Means *contained an exact number of times in something else*. Commonly misused to mean 'subsample.'

ALONG WITH.—Just 'with' will suffice.

ALL OF/BOTH OF.—Just 'all' or 'both' will suffice in most instances.

ALTERNATE/ALTERNATIVE.—'Alternate' implies *first one then the other*. 'Alternative' implies *a choice among 2 or more incompatible objects, situations, or courses of action*.

AMONG.—Use when comparing more than 2 items. Compare with 'between.'

AND, HENCE/AND, THEREFORE/AND, THUS.—"The food supply was reduced *and, thus*, the population declined." Use either the conjunction OR the conjunctive adverb, not both.

APPARENTLY/APARENT.—Mean *obviously, clearly, plainly, evidently, seemingly, ostensibly, or observably*. Choose other wording to make the intent clear.

APPEAR/APPEARS.—Use 'seem(s)'. "He always 'appears' on the scene, but never 'seems' to know what to do."

AS.—A conjunction used in reference to a comparison; always associated with a verb [*e.g.*, "Pocket mice carry seeds in their cheekpouches as (NOT like) do kangaroo rats"]. Do not use in place of 'that' or 'whether.' Compare with 'like.'

ASSUME.—An active verb often used with an inanimate subject to produce a ludicrous statement. "The hypothesis 'assumes' that ..." or "The model 'assumes' ..." Hypotheses

and models cannot ‘assume’ anything. However, to test a hypothesis or to use a model certain ‘assumptions’ often are required. The person who tests the hypothesis or uses the model must make the ‘assumptions.’

AS WELL AS.—Use ‘and’; it means the same.

AT THE PRESENT TIME/AT THIS POINT IN TIME.—Use ‘currently’ or ‘now’; they mean the same.

BELOW.—See comments about ‘above.’ Directions do not change ambiguity.

BETWEEN.—Use when comparing only 2 items. Compare with ‘among.’

BY MEANS OF.—Just ‘by’ will suffice in most instances.

CASE.—Can be ambiguous, misleading, or ludicrous because of different connotations. “In the ‘case’ of Scotch whiskey . . .” Often used in padded sentences. If absolutely necessary, use ‘instance’ (e.g., ‘in this instance’).

CHARACTER/CHARACTERISTIC.—‘Character’ refers to a variable feature (e.g., condition of the tail). ‘Characteristic’ refers to a condition of a character (feature or dimension) of an organism (e.g., tail absent). Also, it can refer to a unique and diagnostic condition of a character (or feature) found in a taxon.

CHECKED.—Imprecise word because of the variety of possible meanings. Commonly used as a synonym for ‘examined’ or ‘verified.’ An example would be, “The traps were checked . . .” Choose the more precise words so that clarity of meaning is maintained.

CLEAR-CUT/CLEAR-CUTTING.—‘Clear-cut’ may be used as an adjective to mean *precise, definite, or distinct*, or as a transitive verb to mean *to remove all trees from an area*. However, the word (commonly with the hyphen omitted) has become a jargon term among foresters and others to mean *clear-cutting or even-aged forest management*. ‘Clear-cut’ may be used only as an adjective or verb, never as a noun; ‘clear-cutting’ is the noun that means *the area from which all trees were removed*.

COMPARE WITH/COMPARE TO.—To ‘compare with’ means *to examine differences and similarities*; to ‘compare to’ means *to represent as similar*. Usually, one ‘compares with’ and ‘contrasts to.’

COMPRISE.—Before common misuse, ‘comprise’ meant *to contain or include*, but not *to constitute or to compose*. The distinction seems useful and worth preserving. Therefore, “The whole ‘comprises’ the parts, but the parts do not ‘comprise’ the whole.”

DECREASED.—Do not use in place of ‘lesser.’ ‘Decreased’ means *to diminish* (as in, size, amount, or strength). ‘Lesser’ is used primarily as an adjective when making a comparison.

DIFFER FROM/DIFFER WITH.—One thing ‘differs from’ another, although you may ‘differ with’ your colleagues.

DIFFERENT FROM/DIFFERENT THAN.—Always use ‘Different from.’

DONE.—Commonly stated as: “Research was ‘done’ in the spring.” Could mean either the research was *completed or conducted* in the spring. Use the correct term to clarify your intended meaning.

DUE TO.—‘Due’ is an adjective often mistakenly used as a preposition. ‘Due to’ implies causality when only a relationship may be intended. Try ‘related to’ or, if causality is intended, use ‘because of.’

DURING THE COURSE OF/IN THE COURSE OF.—Just ‘during’ or ‘in’ will suffice.

EITHER . . . OR/NEITHER . . . NOR.—Apply to no more than 2 items or categories.

EQUALLY AS GOOD/EQUALLY AS GOOD AS.—Use ‘equally good.’

ESTROUS/ESTRUS.—‘Estrous’ is an adjective, ‘estrus’ is a noun. “Among species that have ‘estrous’ cycles, females are receptive only during ‘estrus.’”

FALL.—This word has several meanings including *to descend, to hang freely, to drop suddenly and involuntarily, to flow down, sink, slump, subside, to come or occur at a certain time, and commonly is used as a synonym for the season of Autumn*. Always use the word ‘Autumn’

- for the season occurring between summer and winter to remove any doubt as to intended meaning.
- FARTHER/FURTHER.—‘Farther’ is used as an adverb to mean *to a greater distance in space or to a more remote place*; it is used as an adjective to mean *more divergent in character or relationship or more remote in time*. ‘Further’ is used as an adverb to mean *in addition or moreover*; it is used as an adjective to mean *going or extending beyond what exists*; or as a verb to mean *to help forward, promote, or advance*.
- FAST.—“Foxes were ‘fasted’ . . .” To ‘fast,’ meaning *to starve* is an intransitive verb. “You may ‘fast,’ but you cannot ‘fast’ another organism, you ‘starve’ it.”
- FELT.—“It was ‘felt’ that . . .” One feels cloth, but ‘believes’ ideas.
- FORMER/LATTER.—These words refer only to the first and second of only 2 items or categories.
- GIVEN.—Commonly stated as: “At a given time . . .” This word has several meanings including *fixed, specific, or specified*. Use the more precise term.
- HIGH(ER)/LOW(ER).—These words are used far too often. Commonly used imprecisely or ambiguously for ‘greater,’ ‘less(er),’ ‘larger,’ ‘smaller,’ ‘more,’ or ‘few(er).’ Sometimes gobbledygook is produced, such as, “Occurrences of higher concentrations were lower at higher levels of effluent outflow.” I have no idea what the authors actually meant.
- INCIDENCE/PREVALENCE.—‘Incidence’ means *the number detected or reported per unit of time*. ‘Prevalence’ means *the number or proportion per sample*. “The ‘prevalence’ of rabies in skunks in 1961 was 23 per 1000 examined” or “The reported ‘incidence’ of rabies in skunks in northeastern Illinois averaged 23 per year.”
- INCREASED.—‘Increased’ means *an addition or enlargement* (as in, size, quality, extent, number, intensity, value, or substance). Do not use in place of ‘greater.’ ‘Greater’ means *to be large in spatial dimension, or remarkable in intensity, magnitude, power, or effectiveness*.
- IN ORDER THAT.—Overly wordy, use ‘to.’
- INTERESTING/INTERESTING TO NOTE.—Let the reader decide what is ‘interesting.’ What is ‘interesting’ to you may not be to the reader.
- IN VIEW OF THE FACT THAT.—Overly wordy, use ‘because.’
- IRREGARDLESS.—Actually, this word does not exist! Use ‘regardless’ or ‘irrespective.’
- LAY/LIE.—‘Lay (laid, laid, laying)’ is a transitive verb that requires an object to complete its meaning. It means *to put or set down, to produce and deposit, or to dispose over or along a surface*. “Researchers ‘lay’ traps on the ground” or “Traps were ‘laid’ on the ground.” ‘Lie (lay, lain, lying)’ is an intransitive verb that does not take an object. It means *to be or stay in a horizontal position, to have direction, or to occupy a certain place or position*. “The neonates ‘lie’ in their nest” or “Traps were ‘lying’ on the ground.”
- LESS(ER)/FEW(ER).—‘Less’ refers to *quantity*; ‘few’ refers to *number*. “He drank ‘less’ beer today, so there were ‘fewer’ empty cans.”
- LIKE.—A preposition, always associated with an object (nouns, pronouns, or noun phrases). Used correctly when it replaces the phrases ‘similar to’ or ‘similarly to.’ “Grasshopper mice howl like [NOT as] coyotes.” Compare with ‘as.’
- LIVETRAP/LIVE TRAP.—‘Livetrapped’ (1 word) is a verb, whereas ‘live trap’ (2 words) is a noun. Therefore, animals are ‘livetrapped’ in ‘live traps.’ Hyphenate ‘live trap’ only when used as a noun modifier as in ‘live-trap grid.’
- MAJORITY/VAST MAJORITY.—‘Majority’ means *more than half*. ‘Vast’ suggests *immensity of extent*. Usually, ‘most’ will be more precise.
- MASS/WEIGHT.—These 2 words often are confused. Bodies have ‘mass,’ whereas forces are measured in units of ‘weight.’ Thus, “The average ‘mass’ of adult *Microtus oregoni* from the Coast Range is 19.1 g” or “The pregnant *Peromyscus* weigh 6 g more than the heaviest

- nulliparous specimen.” That is, the pregnant one exerted a force greater than the heaviest nulliparous one equivalent to the Earth’s pull on a 6-g mass.
- MOISTER.—Better to use ‘more moist,’ ‘more mesic,’ or ‘wetter.’
- NON.—A prefix, usually not hyphenated. Avoid overuse. Do not use ‘non’ to substitute for established negative prefixes or where ‘not’ will serve. Use ‘incorrect’ or ‘not correct,’ ‘never noncorrect.’ Similarly, use ‘unreliable’ or ‘not reliable,’ ‘uninfected’ or ‘not infected,’ and ‘not significantly different.’
- NOT INCORRECT/NOT CONSISTENT WITH/NOT UNCOMMON.—Double negatives become incomprehensible. Use ‘correct,’ ‘consistent with,’ or ‘common’ to express positive concepts of correctness, consistency, or commonness.
- ONCE/WHEN/AFTER.—Avoid use of ‘once’ to mean **when** or **after** as ‘once’ can mean *one time, formerly, simultaneously, or immediately*. “When (or After) [NOT once] the mouse located the cache it began to fill its cheek pouches.”
- OUT/IN.—“... 14 ‘out’ of 17 ...,” “... 14 ‘in’ 17 ...,” or “... to find ‘out’ if ...” In most instances, ‘out’ or ‘in’ can be omitted without altering the meaning. Use “... 14 of 17 ...,” “... to find ...,” or “... to determine ...”
- PARAMETER.—A perfectly good word that means *an arbitrary constant each of which values characterizes a member of a system or a characteristic element or constant factor*. However, the word is misused in so many ways that it might be better to avoid its use. Try ‘characteristic,’ ‘dimension,’ or ‘distance.’
- PARTIALLY/PARTLY.—‘Partially’ implies *bias in favor of one or the other*. ‘Partly’ is the more precise term when the concept of *proportion or portion* is meant.
- PERCENT/PERCENTAGE.—Use the percent sign (%) with numerals; use percentage in reference to *proportion of the whole expressed in hundredths*. Compare with proportion.
- PREDOMINATE/PREDOMINANT.—‘Predominate’ is a verb, ‘predominant’ an adjective. The adverb is ‘predominantly,’ not ‘predominately.’
- PRIOR TO/PREVIOUS TO/SUBSEQUENT TO.—‘Previous’ and ‘prior’ are adjectives that modify nouns. There are ‘prior’ and ‘previous’ events, that occur **before** something else. Likewise, there are ‘subsequent’ events that occur **after** something else. However, events do not occur ‘prior to,’ ‘previous to,’ or ‘subsequent to’ something else. Use ‘before,’ ‘proceeding,’ or ‘after’ as usage requires.
- PROBLEM.—Indicates *a question open to inquiry or a proposition stating something to be done*. Often misused. “The potassium ‘problem’ in deer caused ...” Instead, try “Inadequate potassium in deer caused ...” or “Failure to meet potassium requirements in deer caused ...”
- PROPORTION.—Use in the sense of ‘part’ (*e.g., the relation of one part to another or to the whole with respect to magnitude, quantity, or degree*). Compare with percent.
- PROVEN.—‘Proven’ is an adjective, but ‘proved’ is the past participle. Be careful of this word; rarely is anything ‘proven’ in science. Hypotheses are tested and sometimes rejected, but this is not ‘proof.’
- PROVIDED/PROVIDING.—‘Provided’ usually followed by ‘that’ is the conjunction. ‘Providing’ is the participle.
- REASON WHY.—Omit ‘why.’ The ‘reason’ is the ‘why.’
- SAID.—Often used incorrectly as, “Jones (1950) ‘said’ ...” or “Nothing was ‘said.’” Instead, use ‘wrote,’ ‘suggested,’ ‘reported,’ or ‘recorded.’
- SCAT.—Commonly used as a synonym for fecal dropping. Consider substituting ‘feces,’ ‘fecal droppings,’ ‘fecal passage,’ ‘fecal pellets,’ or ‘excrement’ for greater clarity. Scat is imprecise because of numerous other meanings: *a tax, a shower of rain, to scatter, to smash, to beat, to go away quickly, to move rapidly, to sing with meaningless syllables, and is the vernacular name of the argusfish*.

SMALL IN SIZE/RECTANGULAR IN SHAPE/GREEN IN COLOR/TENUOUS IN NATURE.—Something is a size, shape or color; the added words are superfluous. Use ‘small,’ ‘rectangular,’ ‘green,’ or ‘tenuous.’

THAT/WHICH.—“These are 2 words ‘that’ can help, when needed, to make intended meanings and relationships unmistakable, ‘which’ often is of prime importance in science writing.” If the clause can be omitted without leaving the modified noun incomplete, use ‘which’ and enclose the clause with commas or parentheses, otherwise, use ‘that.’

THIS/THESE.—These pronouns (among others) commonly are used to begin sentences when the antecedents to which they refer are unclear. “Elephants, whales, and bats are mammals, although bats fly like birds. These animals are endothermic.” It is unclear whether just the mammals are endothermic, just the birds, or both the birds and mammals. Make sure the antecedents of ‘these’ pronouns are clear.

TO SEE.—“More research is needed ‘to see’ if foxes kill cats.” ‘To see’ means *to perceive by the eye*. Substitute ‘to determine,’ ‘to ascertain,’ or ‘to detect.’

TRAPPED.—‘Trapped’ means *to capture in traps*. Therefore, “. . . study areas were trapped” produces a ludicrous assertion. Use “Traps were set for 3 nights on 4 study areas.”

UTILIZATION/UTILIZE.—‘Use’ will suffice.

VARY/QUITE/SOMEWHAT/CONSIDERABLE.—Avoid use of modifiers that impart indefinite measure. For example, “A ‘very’ large bear . . .” does not provide an indication of how large or provide a scale for judging the relative size of the bear. Either write “A large bear . . .,” or better, “A 3-m tall bear . . .”

VARYING/VARIOUS/DIFFERING/DIFFERENT.—Commonly misused as synonyms. ‘Varying’ amounts or ‘differing’ conditions imply *individually changing amounts or conditions* rather than a selection of ‘various’ amounts or ‘different’ conditions.

WHERE.—Implies a *locality, position, or direction*. Do not use for ‘in which’ or ‘for which.’ “Direct relationships in which [NOT where] muskrats and minks . . .”

WHICH IS/THAT WERE/WHO ARE.—Usually superfluous. “The data ‘that were’ related to age were analyzed first.” Omit ‘that were’; it does not change the meaning. “The site ‘which is’ located near Corvallis, . . .” Omit ‘which is’ for the same reason.

WHILE/WHEREAS.—‘While’ implies simultaneity. Often misused for ‘although’ or ‘whereas.’ Examples are: “*Dipodomys merriami* has 4 toes on each hind foot, whereas [NOT while] *D. ordii* has 5” or “Although [NOT while] deer sometimes chase coyotes, rabbits never do.”

WHO/WHOM.—‘Who’ is used with a relative clause, thus it serves to ask for specification. When you write about animals it is not ‘who’ it is ‘which.’ “The coyote, ‘which’ [NOT who] caught the rabbit, also chased a skunk.” “Researchers ‘who’ discovered the structure of DNA received the Nobel Prize.” ‘Whom’ is used with direct objects. “Whom’ can I trust? Researchers who are ethical.”