

The Craft Of Scientific Writing

Part 2

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Selecting Your Stylistic Tools

Structure:

The organization of detail

The depth of the detail

The transitions between detail

The emphasis of detail

Illustration:

presenting of figures and table

Meshing of figures and tables

Language:

Choice of words

Arrangement of words

The use of numbers, equation, and abbreviations

The use of examples and analogies

Be precise

Be clear

Be forthright

Be familiar

Be concise

Being precise

In scientific writing, precision is the most important goal of language.

Red= wrong
Blue= right

Choosing the right word

Many ordinary words have specific meanings.

Water is **comprised** (**composed**) of hydrogen and oxygen.

Don't grouping words such that they have no meaning.

The problem **centers around** (**centers on /revolves around**) the drying and aging of the bloodstain.

using a word with a positive connotation when a negative or neutral connotation is desired.

The turbulence in the flow **enhances**(**increases**) the drag by more than 20 percent.

Choosing the level of detail

In scientific writing, you should strive not for the highest degree of accuracy, but for the appropriate level of accuracy.

Strong writing requires both general and specific statements.

After recognizing the problems with the solar mirrors, we took subsequent corrective measures.

Our last progress report (March 1985) discussed the damage to ten solar mirrors during a February thunderstorm. The question arose whether high winds or hailstones had cracked those mirrors. Now, after finding that high winds had caused the cracks, we have begun stowing all solar mirrors in a horizontal, as opposed to vertical, position during storms.

Using specific detail because using general statements will not leave much of an impression on your audience.

Our new process reduces emissions of nitrogen oxides from diesel engines and industrial furnaces.

Our new process eliminates 99 percent of nitrogen oxide emissions from diesel engines and industrial furnaces. Previous processes have, at best, reduced nitrogen oxide emissions by only 70 percent.

presenting specific details without general statements can be dangerous.

The average house in the area has a radon level of 0.4 picocuries per liter.

The average house in the area has a radon level of 0.4 picocuries per liter, which is considered low by the EPA [Lafavore, 1987]. Levels between 20 and 200 picocuries per liter are considered high, and levels above 200 picocuries per liter are considered dangerous. For reference, the average radon level in outdoor air is about 0.2 picocuries per liter.

Sometimes specific details confuse because they give too much information.

The number of particular hydrocarbon combinations in our study is enormous. For example, the number of possible C₂₀H₄₂ is 366,319 and the number of C₄₀H₈₂ is 62,491,178,805,831.

The number of hydrocarbon combinations in our study is enormous. For example, the number of possible C₄₀H₈₂ is over 60 trillion.

Being precise doesn't mean compiling details; being precise means selecting details. You should choose details that inform.

Being Clear

Avoiding needless complexity

Needlessly complex words

Category	Example	Possible Substitute
Nouns	Familiarization	Familiarity
	Has the functionability	Can function
	Has the operationability	Can operate
	Utilization	Use
Verbs	Facilitate	Cause
	Finalize	end
	Prioritize	Assess
	Utilize	use
Adjectives	aforementioned	Mentioned
	Discretized	Discrete
	Individualized	Individual
	Personalized	Personal
adverbs	Firstly secondly third	First, second, third
	Heretofore	Previous
	Hitherto	Until now
	Whereas	while

Needlessly complex phrases

One source of needless complexity in phrases comes from stringing modifiers in front of nouns.

Solar One is a 10 megawatt solar thermal electric central receiver Barstow power pilot plant.

Solar One is a solar-powered pilot plant located near Barstow, California. Solar One produces 10 megawatts of electric power by capturing solar energy in a central receiver design.

The modifiers become lost in the string, long strings bring imprecision into sentences.

The decision will be based on economical fluid replenishment cost performance.

We will base the decision on the cost of replacing the thermal oil.

Avoiding ambiguity

Ambiguity is created by the use of a word, phrase, or sentence that can be interpreted in more than one way.

Radiometer System. Two general requirements to be met are (1) to survive and accurately measure the radiation incident on the receiver and (2) to present the data in a form that can be used to verify computer code predictions.

Radiometer System. The radiometer system for the solar receiver must meet three requirements: (1) it must accurately measure to within 5 percent the solar radiation on the receiver; (2) its electronics must survive in solar radiation as intense as 300 kilowatts per square meter; and (3) its output must be able to verify computer codes.

Ambiguities in word choice

T cells, rather than B cells, appeared as the lymphocytes migrated to the thymus gland.

T cells, rather than B cells, appeared because the lymphocytes migrated to the thymus gland.

Ambiguities in syntax

Only I tested the bell jar for leaks yesterday.

I *only* tested the bell jar for leaks yesterday.

I tested *only* the bell jar for leaks yesterday.

I tested the bell jar *only* for leaks yesterday.

I tested the bell jar for leaks *only* yesterday.

In low water temperatures and high toxicity levels of oil, we tested how well the microorganisms survived.

We tested how well the microorganisms survived in low water temperatures and high toxicity levels of oil.

Ambiguities in pronouns

There are no peaks in the olefinic region. Therefore, no significant concentration of olefinic hydrocarbons exists in fresh oil. This places an upper limit on the concentration of olefins, no more than 0.01 percent.

The chromatogram has no peaks in the olefinic region. Therefore, no significant concentration of olefinic hydrocarbons exists in fresh oil. This chromatogram finding places an upper limit on the olefin concentration, no more than 0.01 percent.

Ambiguities in punctuation

The three elements were hydrogen, oxygen, and nitrogen.

In our study, we examined neat methanol, neat ethanol, methanol and 10 percent water and ethanol and 10 percent water.

In our study, we examined four fuels: neat methanol, neat ethanol, methanol with 10 percent water, and ethanol with 10 percent water.

Being forthright

Controlling tone

Avoiding Pretentious Words.

utilize: a pretentious way to say the verb *use*. You should challenge *-ize* verbs. Many times, there is a simpler substitute.

utilization: a pretentious way to say the noun *use*. You should challenge *-ization* nouns.

Avoiding arrogant phrase

As is well known, the use of gaseous insulation is becoming increasingly more widespread, with gases such as air and sulphur hexafluoride featuring prominently.

The results **clearly demonstrate** the ability of Raman spectroscopy to provide unambiguous chemical compound identifications from oxides as they grow on a metal surface.

The results show that Raman spectroscopy can identify chemical compounds from oxides that are growing on a metal surface.

Choosing strong nouns and verbs

Using strong nouns

The existing nature of Mount St. Helens' volcanic ash spewage was handled through the applied use of computer modeling capabilities.

With Cray computers, we modeled how much ash spewed from Mount St. Helens.

Using Strong Verbs

Weak Verb Phrase

made the arrangement for

made the decision

made the measurement of

performed the development of

Strong Verb

arranged

decided

measured

developed

The human immune system is responsible not only for the identification of foreign molecules, but also for actions leading to their immobilization, neutralization, and destruction.

The human immune system not only identifies foreign molecules, but also immobilizes, neutralizes, and destroys those molecules.

Buried Verb

is beginning

is following

is shadowing

is used to detect

Strong Verb

begins

follows

shadows

detects

The distance between the electrodes is dependent on the pressure environment and the result of metal corrosion.

A *positron* is a positively charged electron produced in the beta decay of neutron-deficient nuclides.

Needlessly passive verbs slow your writing; they reduce your writing's efficiency.

The feedthrough was composed of a sapphire optical fiber, which was pressed against the pyrotechnic that was used to confine the charge.

The feedthrough contained a sapphire optical fiber, which pressed against the pyrotechnic that contained the charge.

Sometimes passive voice is more natural

On the second day of our wildebeest study, one of the calves wandered just a few yards from the herd and was attacked by wild dogs.

The key to choosing between an active and passive verb is to ask which form is more natural.

How do you take needlessly passive writing and make it active?
Suppose in the first draft of a section about using an oscilloscope, you write

The voltage was given on the oscilloscope.

You want to convert that sentence to the active voice.

The oscilloscope displayed the voltage.

comfortable

The oscilloscope measured the voltage.

marginal

The oscilloscope calculated the voltage.

uncomfortable

Avoiding the first person at every turn leads to unnatural wording:

In this paper, the authors assumed that all collisions were elastic.

avoiding the first person include

It was determined that...

It was decided that...

It was attributed to ...

Being familiar

Avoiding Unfamiliar Terms

PPF: Pulsed Power Facility

Jarva: a neodymium-glass laser in the facility

For the first year, the links with SOPC and the HAC were not connected, and a11 required OCS input data were artificia11y loaded. Thus, CATCH22 and MERWIN were not available.

Because some of the links in the computer system were not connected the first year, we could not run a11 the software codes.

Defining Unfamiliar Terms

When you cannot write around unfamiliar terms, then you have to define them.

If a definition is short, you can include it within the sentence:

In a central receiver system, a field of sun-tracking mirrors, or *heliostats*, focuses light onto a solar-paneled boiler, or *receiver*, mounted on top of a tall tower.

The thermal oil is a mixture of many *aliphatic hydrocarbons*

When the definition is complex or unusual, you should expand your definition to a sentence or two.

Bremsstrahlung is the radiation emitted by a charged particle that is accelerated in the Coulomb force field of a nucleus. The term originates from the German words *Bremse* (brake) and *Strahlung* (radiation).

If the abbreviation occurs only a couple of times in the document, then you should avoid the abbreviation and write out the expression. If, however, the abbreviation occurs several times, then you should define the abbreviation the first time it's used.

In a central receiver system (CRS), a field of solar mirrors focuses sunlight onto a central boiler or receiver. An example of a CRS is the Solar One Power Plant located near Barstow, California. Another example of a CRS is ...

Incorporation examples and analogies

Two of the best tools for explaining unfamiliar concepts are examples and analogies.

Since the design of the Solar One Power Plant, significant advances have occurred in solar energy technology. For example, experimental tests have shown that using molten salt, rather than water, as the heat transfer fluid could increase overall system efficiency from 17 percent to 25 percent.

In the brightness tests, the maximum retinal irradiance was less than 0.064 w / cm^2 , a brightness about that of a household light bulb.

The Hanford Nuclear Reservation contains 570 square miles, which is about half the size of Rhode Island.

Being concise

Eliminating redundancies

Redundancies either repeat the meaning of an earlier expression or else make points implicit in what has been stated.

The aluminum **metal** cathode became pitted during the glow discharge.

The use of gaseous insulation **is becoming increasingly more widespread**.

Scientists are using gases more as insulators.

Eliminating writing zeroes

Certain phrases have no meaning at all.

It is interesting to note that over 90 incidents of satellite fragmentations have produced over 36,000 kilograms of space debris.

Some other writing zeroes are:

as a matter of fact

I might add that

it is noteworthy that

it is significant that

it should be pointed out that

the course of

the fact that

the presence of

Vibration measurements made in the course of the missile's flight test program were complicated by the presence of intense high-frequency excitation of the vehicle shell structure during the re-entry phase of the flight. (33 words)

Vibration measurements made during the missile's flight were complicated by intense high-frequency excitation of the vehicle shell during re-entry. (19 words)

Reducing sentences to simplest forms

Many reductions occur within phrases.

Fat Phrase	Reduction
at this point in time	now
at that point in time	then
has the ability to	can
has the potential to	can
in light of the fact that	because
in the event that	if
in the vicinity of	near
owing to the fact that	because
the question as to whether	whether
there is no doubt but that	No doubt

The achievement of success in these advanced technologies depends very heavily on a rather detailed understanding of the complex processes that govern the velocities in the unburned gases prior to combustion. (31 words)

The success of these advanced technologies depends on understanding the velocities in the unburned gases prior to combustion. (18 words)

Thanks