

A reprint from

American Scientist

the magazine of Sigma Xi, The Scientific Research Honor Society

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Writing to Facilitate Reading

Supplying full grammatical closure to main clauses makes a significant difference in reader comprehension.

George D. Gopen

In the past decade, I have examined the writing of several thousand scientists. So far, none have been free of a malady that I call the *main clause first problem*.

In the November–December 2022 issue of *American Scientist*, I explored the nature of the *stress position*. A stress position occurs whenever the grammatical structure of a sentence comes to a full halt. The syntactic closure provided by these marks of punctuation invites a reader to read the last words with additional emphasis. Yet most of us place the most stress-worthy information elsewhere in the sentence, forcing our readers to guess for themselves which words to emphasize.

The main clause first problem that I deal with here is a subcategory of the larger stress position problem. Simply stated, it occurs when a main clause ends with none of the punctuation marks that can produce a stress position—a colon, semicolon, or period.

A *unit of discourse* is any group of consecutive words that has a beginning and an end. Of the many units we were taught in grammar classes, there are only three that influence how readers understand writing.

The first and most important of these is the *main clause*. It contains a subject and a verb; it can stand by itself as a complete sentence.

The second is referred to as the *dependent clause*; but in context, it makes

more sense to call it the *qualifying clause*. It covers all clauses that do not rise to the level of a main clause because, despite having a subject and a verb, it cannot stand as a sentence by itself. This disqualification is usually caused by it beginning with a word such as “if,” “since,” “that,” “which,” or “although.” The job of these clauses is not to “depend” on the main clause but rather to “qualify” it.

When a main clause ends with none of the punctuation marks that can produce a stress position, it forces readers to guess for themselves which words to emphasize.

The third unit of discourse we must keep in mind is a *phrase*. It does not rise to the level of a clause because it lacks a subject and verb.

We need to be able to recognize these three units of discourse because, by their very nature, they send instructions to our readers as to how much weight should be given to the information located there.

The main clause says, “I am so whole and so important that I could stand by myself as a sentence. I therefore contain something of importance. *Stress something in me.*”

The qualifying clause says, “Although I contain both a subject and a verb, and therefore carry some weight and dignity, my sole purpose here is to help modify or support or qualify my more important sibling, the main clause. *Do not stress anything in me.*”

The phrase says, “I am just some extra information you should know. *Do not stress me.*”

It is essential that these instructions do not conflict with the instructions sent by the presence or lack of a stress position. If you put stress-worthy material in either a qualifying clause or a phrase, both of which say “don’t stress me,” you confuse your reader. The material in question may sound stress-worthy, but the unit of discourse it inhabits instructs the reader not to stress it.

If you put stress-worthy material in a main clause, but supply for it no stress position, you also confuse your reader: The main clause invites the reader to stress something in it; but its lack of a stress position tells the reader not to stress anything. This conundrum is the constantly recurring problem in scientific writing that I am calling the *main clause first problem*.

The result of this main clause first conflict is confusion for the reader.

QUICK TAKE

Scientist writers need to understand the parts of a sentence and how they cue the reader to make decisions about what words or ideas are the most important.

Pairing the correct parts of a sentence, called *units of discourse*, with the appropriate punctuation, will give readers clear and nonconflicting instructions on what to stress.

Writing with attention to these sentence elements can both clarify the writer’s intentions and reduce the amount of effort required from readers.



Acquired by Henry Walters with the Massarenti Collection, 1902

Allegory of Grammar by Laurent de La Hyre (1606–1656) depicts grammar as a woman holding a Latin scroll that translates as “A meaningful and literate word spoken in the correct manner.” Her watering plants is a symbol for how understanding grammar can encourage young minds to grow. Similarly, understanding the role of clauses and punctuation in cueing reader emphasis can lead to better comprehension.

That confusion—especially because it happens so often—can mislead your readers in their efforts to grasp your meaning. It will also tire them out.

Whenever you end a main clause with a comma (which is incapable of producing a stress position) or with no punctuation whatever, you are leaving it up to your readers to make the important decisions about emphasis that you should have been making for them. There they are, in the middle of your sentence, with some portion of their mind needing to reflect backward, trying to decide whether or not they should have stressed something, and, if so, what. But most of their mind is hurtling forward to finish the job of reading your sentence. You have essentially made them into your coauthors.

In looking at the writing of thousands of scientists, I have calculated

that almost 46 percent of all scientific sentences force their readers to become coauthors. No wonder we, as readers, so often feel relieved to have made our way to the end of a scientific document. No wonder we so often at that moment suffer a real sense of fatigue. We have had to work far too hard—and with questionable results.

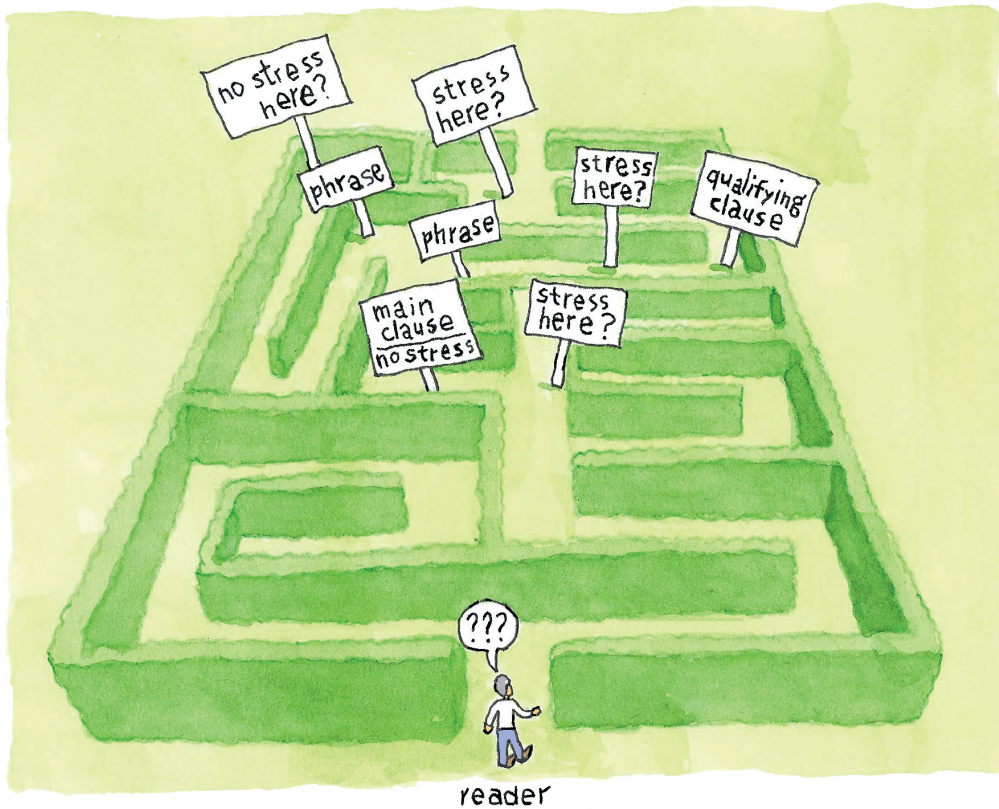
What to Stress

Looking at some typical scientific sentences of two clauses or more, I use a double slash (//) to indicate any moment in a sentence when we could insert a period without offending any rules of grammar. We will find a // at the end of every main clause without a stress position because, as a proper main clause, it could stand by itself as a sentence; but often we will find that double slash a few words later as well, where the sen-

tence once again could have properly been brought to an end. A simple single clause in an English sentence averages from 12–15 words; scientific documents average 26–29 words per sentence. Thus, the average scientific sentence contains an average of two clauses, which invites the possibility of a main clause first problem. Here is one example sentence:

Inhibition of CMA in heart unexpectedly confers resistance to stress-induced cardiac dysfunction in both pressure overload and myocardial infarction models, which is opposite to MA deficiency in heart, and differs from CMA deficiency in other tissues.

This sentence could have ended at the first comma, without offending any grammar teacher, because those 20 words form a main clause; the rest of the sentence is a qualifying clause—a “which” clause. The 20-word main clause can stand by itself as a sentence; the qualifying clause cannot.



Reading a sentence becomes a maze of comprehension problems when readers are given conflicting instructions on what parts of the sentence to stress. Readers encountering positions in the sentence where they expect a cue to stress something will experience a kind of interpretive tension when they do not receive that cue. They are forced to double back and see if they missed something while they also try to continue forward reading the sentence and interpreting its meaning.

But the trouble starts earlier than that comma. As a first-time reader, when I reach the 12th word, “dysfunction,” I have already experienced a whole main clause—and therefore have been handed enough for a whole sentence. Words 13–20 are a phrase that further describes where the dysfunction might occur. The natural weight of that initial 12-word main clause suggests that something in the sentence so far deserves emphasis:

Inhibition of CMA in heart unexpectedly confers resistance to stress-induced cardiac dysfunction //

But because, as a reader, I *could* stop there, my forward motion toward the expected closure of the stress position that did not materialize raises a kind of interpretive tension in me. I could stop; I perhaps want to stop; but I am not allowed to stop. It is both a retroactive-leaning and a forward-looking problem.

Retroactively, the question becomes, How should I have been reading these 12 words? There is enough for a full sentence here; should I already have

stressed something? And if so, what? Consider the number of reasonable candidates for stress: “inhibition of CMA”; “in heart”; “unexpectedly”; “confers resistance”; and “stress induced cardiac dysfunction.” That makes five. But perhaps I should be stressing more than one. Or, importantly, believing the lack of punctuation here, which tells me not to stress anything yet, perhaps I should stress nothing. All of these decisions have to be made by the reader retroactively at the clause’s end; but at that confusing and unconfident moment, the mind is also barreling forward to finish reading the sentence. Hence, the problem: We have been given two conflicting instructions at the 12-word mark—“stress something here” and “do not stress anything here.” Thereafter, we will be reading units other than a main clause that tell us “do not stress anything here”; but at their end, we find a period that instructs us “stress something here.” This structure causes a serious reading problem—highly likely to occur several times on every page.

It was the responsibility of the writer first to make those decisions for the

reader and then to communicate them clearly. The sentence’s structure, signaled by its punctuation, should allow the reader to continue reading forward without either mental interruption or undue interpretive burden. As readers, we should be able to trust that the most important material will appear in a stress position. If, as a writer, you can manage to do that for your readers on a regular basis, they will quickly learn to trust you.

So far, even though we have looked at only 12 words of our 36-word sentence example, we have already overtaxed our supply of reader energy for this sentence. Too much has been left to the reader being able to make reasonable guesses.

Here is the same example with double slashes for every time the sentence might have come to an end:

Inhibition of CMA in heart unexpectedly confers resistance to stress-induced cardiac dysfunction // in both pressure overload and myocardial infarction models, // which is opposite to MA deficiency in heart, // and differs from CMA deficiency in other tissues. //

A sentence is “too long” not when it exceeds a certain number of words, but rather when it has more viable candidates for stress positions than it has stress positions.

At each of those double-slash moments, the readers once again have to decide what, if anything, they should be stressing along the way. Recall that there were five reasonable candidates in the first 12 words alone. The sentence sounds professional and dignified, but it is an interpretive headache.

This sentence was written by a highly intelligent and professionally competent scientist; but if we try hard to decide for ourselves as readers which pieces of information we should stress here, we come away with a mistaken sense that she is somewhat disorganized or perhaps just a pedestrian thinker. Over multiple occurrences of this decision-making on every page of the document, the cumulative effect is

hard for the reader to bear: Once you have guessed wrong as to what the writer meant in one clause, all your subsequent guesses will be based more on sand than on concrete.

Here is the revision the writer and I devised, based on her decisions concerning stress-worthiness. We made sure not only that each main clause contained stress-worthy information, but that the stress-worthy material appeared at the main clause's end, in the stress position created by the period. That structure eliminated the "stress something" versus "stress nothing" conflict:

Inhibition of CMA in heart unexpectedly confers resistance to stress-induced cardiac dysfunction. This happens in both pressure overload and myocardial infarction models: In heart, this is opposite to MA deficiency; in other tissues, it differs in CMA deficiency.

As readers, we can feel confident in leaning forward to the moments of stress signaled by the periods, the colon, and the semicolon. Having perceived, clearly and easily, what she wanted us to stress, we are leaning forward to the next sentence.

It is in our best interest, psychologically, to believe we are as competent a reader as the author is a writer. The truth of the matter is that our non-comprehension can be real—and is often the fault of the author.

Hidden Problems

Another example, at first glance, might seem relatively unproblematic. The worst of all sentences are not those that cry out how challenging they are; instead, they are those that seem faultless but fail to deliver their message to a majority of the reading audience.

The problem continues to flourish,
// despite efforts by Congress to
enhance opioid prescription monitoring
// to limit drug diversion //
and trafficking, // suggesting that a
novel strategy is needed. //

From the brain of the writer to the brain of the reader, how could this sentence go awry? Let me write for you an accurate yet annoying single-sentence tour guide for this sentence's readers, describing its reading as a slow-motion process. I intend it to burden you consciously in the way your mind uncon-

sciously struggled while reading the sample sentence for the first time.

Right off the bat we are handed a full main clause ("The problem continues to flourish"), which could easily have been the end of the sentence, allowing us a stress position, but it refuses to end and is followed by a phrase ("despite efforts by Congress"), the efforts of which are then described by the phrase "to enhance opioid prescription monitoring," with that "monitoring" then getting identified by the phrase "to limit drug diversion," which could have ended the sentence

The worst of all sentences are not those that cry out how challenging they are. They are those that seem faultless but fail to deliver their message to a majority of the reading audience.

but instead adds the feature "and trafficking," which certainly could have been the end of the sentence, but, to our increasing sense of burden, is followed by a whole new qualifying clause ("suggesting that a novel strategy is needed"), which, though new it may be as a grammatical structure—and one that ends with a period, thus signaling the single stress position in the sentence and inviting emphasis, even though it is only a qualifying clause—sounds suspiciously like the main clause we encountered so long ago, maybe.

I trust my sentence was burdensome to read—one long, rambling sentence, with several interruptions and backward looks, always frustrating your journey toward closure. Its only stress position contained the anti-stress word "maybe." Whereas you, reading the original for the first time, may not be conscious of having to make all these judgments and revisions of judgments, your reading process is being taxed in much the same way as it was by my guided tour. If you have 10 readers

try to rewrite this example, producing a stress position for everything they think the writer intended us to stress, you will be likely to get anywhere from four to eight different revisions.

When the author thought about revision in this manner, here are the decisions he reached: Two stress positions were needed, one for the problem's "flourishing" and another for the need to devise a new strategy to solve it; and the attempts by Congress ought not to be stressed, as they are there mainly to help produce context for the rest of the sentence.

Given the newfound clarity of the author's intentions, the revision was relatively easy to accomplish. Congress's activity deserved only a phrase, near the beginning of the sentence, where contextualizing naturally takes pace. Care should be taken to warn the reader that "limiting" will be applied to a pair of activities—to drug diversion and to trafficking. All that, in the "don't stress me" unit of a phrase, should lean forward to a main clause, ending with "flourishing" in a stress position. Then there should be another main clause, with another stress position, to signal the importance of the need for a novel strategy. This revision accomplished, the reading becomes easy, forward-flowing, and confidence-breeding:

Despite efforts by Congress to limit both drug diversion and trafficking by enhancing opioid prescription monitoring, the problem continues to flourish: A novel strategy is needed.

If we could provide this kind of clarity for each of the 100–150 sentences found in a typical journal article, think what a joy scientific reading might become.

Revision Process

Are you beginning your sentences on a regular basis with a main clause that has no colon, semicolon, or period at its end? As a new part of your revision process, decide whether that main clause contains stress-worthy information or not. If it does, you have two remedies: Leave the main clause at the beginning, ending with a colon or semicolon, whichever suits the occasion; or move this main clause to the end of the sentence, where it can benefit from the stress position created by the period. If, on the other hand,

you decide there is no stress-worthy information in this main clause, you would do well to demote the main clause structurally by making it either a qualifying clause or a phrase. When you get used to doing this on a regular basis, your documents will become more and more reader-friendly.

It is better not to begin trying these new methods in the process of writing a first draft. They will constantly interrupt your normal procedures, because they will be challenging many of your long-held writing habits. Use them at first as part of a revision process. Take what you have written and discover for each sentence the answers to two important questions: Does everything I want the reader to stress occupy a stress position? And do any of my main clauses end without the presence of a colon, semicolon, or period? You will soon grow to recognize when there is a stress position or main clause first problem.

It may well be a bit of a struggle at first to make the appropriate structural revisions. Overcoming long-established habits is difficult indeed. But the more you change them, the better you will get at it. If you fail in your effort to revise a given sentence, let it go. Succeeding 50 percent of the time on a first attempt is a good result.

If you persevere, after just a few documents, you will find these new principles becoming habits that will eventually infiltrate the initial drafting process. After a while, it will all become natural. This process will slow you down for a few documents, but once it becomes part of your initial writing process, your writing will take you less and less time, with better and better results.

Here is an example of a revision process where a main clause does not contain stress-worthy information and needs to be demoted:

TB is one of the top 10 causes of death globally, // and now the leading cause of death from a single pathogen worldwide, // surpassing HIV.

This sentence begins with an 11-word main clause without a stress position; we then get a phrase that could have ended the sentence; but we are asked to extend our energy for another two-word phrase, “surpassing HIV.” Was “surpassing HIV” intended to be the only emphasis? If so, why are those two words presented to the reader in a lowly phrase?



Writers who review every sentence they have written to ensure that everything they want the reader to stress occupies a stress position, and that their main clauses end with a colon, semicolon, or period, create a clear path for readers to comprehend their meaning without confusion or fatigue.

What if the author wanted us to stress “top 10 causes of death”? In that case, we need to move the main clause it inhabits to the end of the sentence; and we need get that top 10 statistic (instead of “globally”) all the way to the stress position at its end. In that scenario, the work of the word “globally” has already been done by the word “worldwide.” Here is the result of that revision:

Now the leading cause of death from a single pathogen worldwide, surpassing HIV, TB has become one of the top 10 causes of death.

But what if I guessed wrong about the writer’s intentions? What if the most noteworthy piece of information here was intended to be the seemingly redundant term “globally”? By reducing most of the rest of the sentence’s information to a mere contextualizing phrase, which would then clearly lean

forward to the sentence’s main clause, we could ensure that “globally” will shine in the stress position’s moment of closure. Then the repetitive quality of “globally” would be interpreted not as wordiness but as emphasis:

Now the leading cause of death from a single pathogen worldwide, surpassing HIV, TB has become one of the top 10 causes of death globally.

But what if the author instead wanted us to stress “single pathogen”? Then that term should inhabit the sentence-ending main clause:

One of the top 10 causes of death globally, and now surpassing HIV, TB has become the leading cause of death from a single pathogen.

What if the author also wanted us to stress that TB has now surpassed HIV? Then we create for HIV another main clause—with its own stress position:

One of the top 10 causes of death globally, TB is now the leading cause of death from a single pathogen: It has even surpassed HIV.

Where grant applications are concerned, carefully crafting your sentences so that every piece of stress-worthy material inhabits its own stress position can lead directly to funding. There are lots of good ideas out there, asking to be funded; but if your good idea is written so clearly that your fund-controlling reader is both properly instructed by it and delighted by it, you are likely to triumph over the competition.

Types of Stress

A major cause of these ubiquitous problems in scientific writing is, I believe, that we never alter our sense of what the writing task is supposed to accomplish once we have completed our schooling. There, our purpose was to prove to our teacher that we had done enough work to deserve a good grade. Our rhetorical task was one of *demonstration*. In the scientific world, the task changes. Now we, not some teacher, are the experts in what we know. We write to convey that knowledge to readers who do not already possess it. Our rhetorical task has become one of *communication*.

The scientific writer—in every single sentence—must send readers

the correct instructions for how they should put all these words together. Without knowing the crucial importance of the stress position, and without understanding how different units of discourse (main clause, qualifying clause, and phrase) send different instructions concerning what information should and should not be considered important, we cannot control our readers' interpretive process.

When we are 15 years old, we have been writing for about 10 years. We have developed in our brain a sentence-writing "machine." It has a "start button" on it. If you are called on to write a sentence, you push the start button, and the machine bursts into action: "Choose a subject. Choose a verb. Unravel your complement. Put a period." You want to write another sentence? Push the button again. Then you turn 18, go to college, and start reading primary sources instead of textbooks. It does not take long for you to discover that these important people sound different from you. Two main reasons: They use a lot of hard words; and their sentences go on for twice as long as yours. So when you have to write a college paper, what are you going to do? You are going to do what you always have done: You will push the button. "Choose a subject. Choose a verb. Unravel your complement. Put a period . . . No! I have to go on twice as long as I used to. I'll put a comma and keep going." And on you go. You are constantly producing a main clause first problem. You used to write primarily one-clause sentences. Now you have to write two-clause sentences. No one has taught you the difference.

For all those precollege years, because most of your sentences were made up of just a single main clause, your act of beginning the writing of a sentence was exactly the same as your act of beginning the writing of a main clause. That process became a habit. There was no one around later on to tell you that if you usually begin your sentence with a main clause but give your reader no stress position, your reader is already in deep trouble. You have already lost control of the structure of your own sentence. You have lost the ability to indicate what the reader should stress.

To remedy this deficit, I have devised a four-part typology of two-clause sentences. It should cover al-

most all of the two-clause sentences you will ever have to write.

In the first type, I have written a sentence in which two main clauses are separated by a comma. The period at the end establishes a single stress posi-

Take what you have written and ask yourself for each sentence, Does everything I want the reader to stress occupy a stress position?

tion. In thinking more about the sentence, I decide that the first main clause contains something worthy of stress; but the more I contemplate these two statements, the more I believe that the second one deserves its own separate unit. How can I produce both a stress position for the first clause and isolation for the second? To do so, I put a period at the end of the first clause; and then I begin the second with a capital letter. Both now have stress positions. They live separate lives.

In the second type, again, my sentence has two main clauses, separated by a comma. Again, the first main clause contains something important enough to be stressed. But the relationship between the two clauses is different here: The second clause restates or exemplifies the first. How can I both create a stress position for the first and advertise that the reader should be expecting a full main clause restatement of it in the second? To do so, I put a colon at the end of the first clause; and I begin the second with a capital letter, indicating it will have enough in it to stand by itself as a whole sentence.

In the third type, my sentence again contains two main clauses, separated by a comma; and again, the first clause requires a stress position. But the relationship between the two clauses here is different: The first clause is part one of a two-part thought; the second clause is the completion of that thought. Both require stress positions. To signal this structure, I put a semicolon at the end of the first clause. Semi-

colons tell the reader, "Hold onto part one, stressing its end; and now part two is beginning, with stress expected at its end."

In the fourth type, this time they are not both main clauses: One is a qualifying clause. How can I produce for the main clause a stress position? I can move the main clause to the end of the sentence: There it will benefit from the period creating a stress position. If the qualifying clause, appropriately, contains no stress-worthy material, how can I signal the reader both that it is over and that no stress should be applied? I can move the qualifying clause to the beginning of the sentence: There, by using a comma, I can signal the reader not to stress anything in it.

If we review these four revised sentence types together, we discover something powerful and elegant: Their purposes are distinguished from one another by the punctuation marks that occur between the two clauses. Taken together, they comprise the four main punctuation marks of the English language—period, colon, semicolon, and comma. If you can master the differences these four make in the middle of multiclausal sentences—the different instructions they send to the reader—then you can control any two-clause scientific sentence, no matter how long or complex. These marks of punctuation send to your readers two important instructions: They tell the reader whether or not to stress something in the first clause; then they reveal what the relationship will be between the first clause and the second.

If all scientific writers, writing in English, could produce a stress position for every morsel of material that requires stress, all readers of that prose could leave off their jobs as coauthors and become pure readers—always moving forward both within a sentence and from sentence to sentence. Ideas and information could be communicated accurately from writer to reader. And blissfully, readers would arrive at the end of every document delighted to have encountered it, with no trace of unnecessary fatigue.

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