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Getting the Point Across

Successful science writing places each sentence's emphasis where readers expect it—in the stress position.

George D. Gopen

How often do you arrive at the end of reading a scientific article or grant application and feel devastated that it had not been longer? How often do you jump up from your desk and rush to find colleagues to share with them this uplifting document so they might also experience your joy? I imagine you would have to answer, “Not often.” Instead, do you as a reader not tend to feel relief when you reach the document's end? You are probably more tired than you were when you began. That fatigue is not only a problem in itself: It signifies a great probability that, on a sentence-by-sentence basis, you have failed to perceive the writer's intended meaning clearly and with as little effort as possible.

It is the writer's job to convey meaning; it is the reader's job to perceive meaning. If the writer has not performed their job adequately, the reader may well come away with an entirely different meaning than the writer intended. If the reader arrives at the end of the sentence having received *something*, even a muddy, loosely defined something, the reader has every reason to believe the reading job has been adequately accomplished. In parallel fashion, since the writer knew what the sentence was intended to mean, and the sentence seemed capable of meaning that, containing all the correct and pertinent information, the

writer may also be well satisfied that the writing job has been accomplished.

There you have it: The writer thinks the writing was well enough done; the reader thinks the reading was well enough done; but the thought may somehow have failed to be conveyed clearly from the mind of one to the mind of the other. Such failed efforts

If readers are naturally going to give emphasis in a stress position, then writers ought to learn to locate in that stress position the information they most want the reader to stress.

at communication happen in a shockingly large percentage of scientific sentences. We can do better. We can do much better.

In the medical field, there are ailments that defy our abilities to treat, ailments that can be somewhat managed, and yet others that can be cured. Inadequate scientific writing—

ubiquitous and woefully unattended to—is an ailment that can be cured. In my more than 40 years of analyzing professional prose, I have identified two major flaws that are ubiquitous in scientific writing. By addressing these two flaws, you can ensure that you and your reader come away from each sentence of your work with the same understanding.

The first I call the *stress position* problem. There are places in the structure of English sentences where readers naturally exert extra emphasis. We all know this instinctively as readers; my job here is to make you conscious of it as writers. If you regularly deposit the material you want stressed in a stress position, your readers are far more likely to stress the right words and thus correctly perceive your meaning.

The second flaw I call the *main clause first* problem, which occurs when the most important part of the sentence (the main clause) does not have a stress position. In the 12 years I have been on the lookout for this flaw in one-on-one sessions with thousands of scientists, I have yet to find a single person who does not suffer from it. Being a specialized and recurring kind of stress position pitfall, the main clause first problem requires a great deal of attention. It will appear as the second half of this essay, forthcoming in the January–February 2023 issue of *American Scientist*.

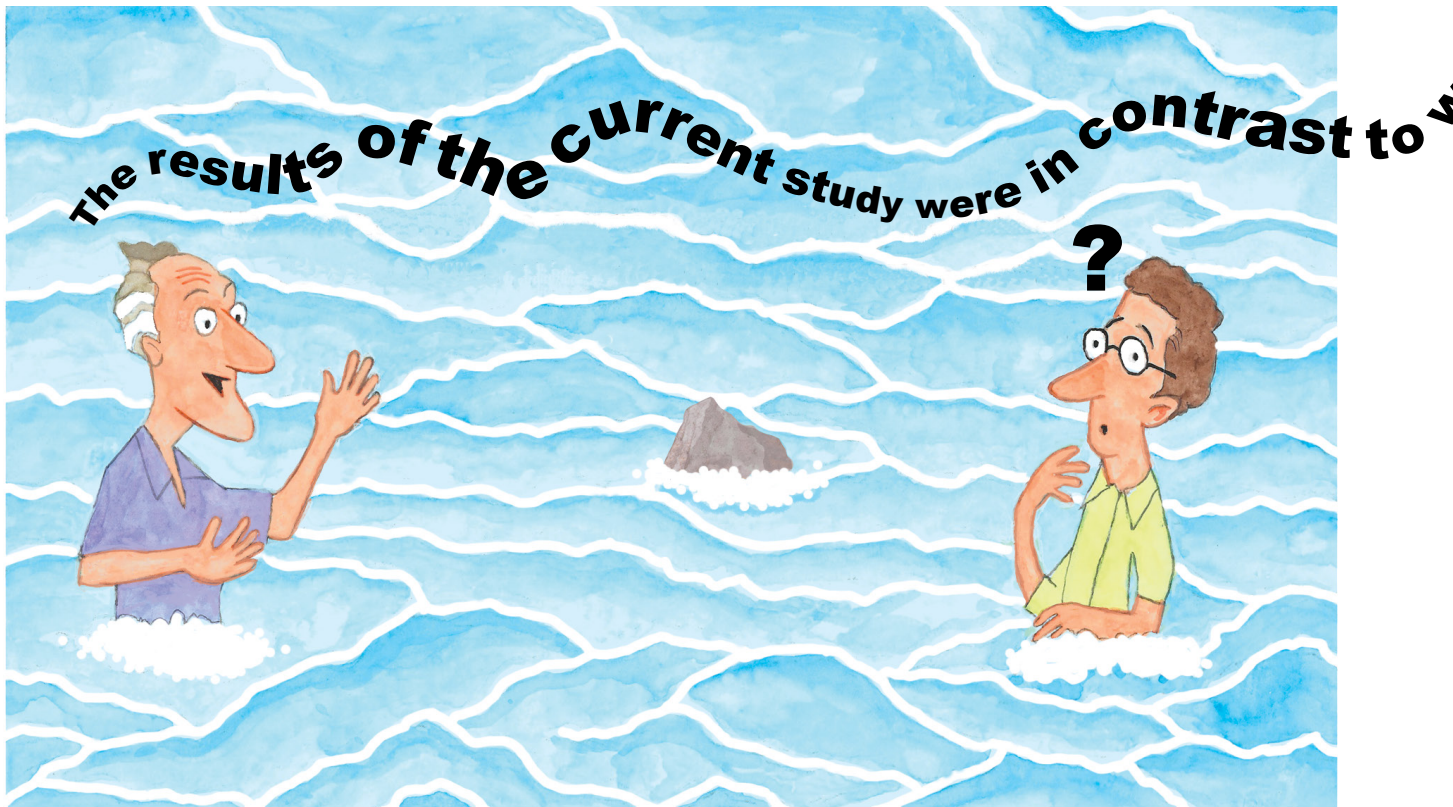
No matter how well you write already, overcoming these two problems

QUICK TAKE

Science writers often fail to clearly express the ideas in their work. If a reader misunderstands an article or grant proposal, that is the fault of the writer, not of the reader.

Knowing how to place the most important idea of each sentence where the reader expects to find it—in the stress position—ensures that the author's meaning is accurately conveyed.

Writing with readers in mind protects authors' control over the meaning of their works. It also greatly improves the likelihood of success with publications and grant applications.



Tom Dunne

Unsuccessful writing disrupts the author's ability to transmit meaning to the reader, like a river diverted by a rock midstream. Science writing should come close to meaning only one thing to all of its readers—and so clear prose is essential. Writers who understand readers' expectations can more fluidly convey their ideas, making for a more successful product. Placing the important words in a sentence's stress position ensures that the reader's emphasis will produce what the writer intended.

will transform the quality of your writing for the better. It will also (eventually) reduce the time you need to spend writing. If you are in the business of submitting articles for publication and applications for funding, addressing these problems will improve both your curriculum vitae and your cash flow.

The Stress Position

At the beginning of our reading of any sentence, we take a mental breath to summon what I will call the *reader energy* necessary to do interpretational battle with most normal-sized professional sentences. That energy having been summoned, we attempt to proceed without hindrance through the sentence until, at its end, we can affect closure for that sentence; only then can we exhale and summon a new breath to move on to the next one. The closer we come to the closure we are expecting, the more important it becomes that not only do we achieve that closure, but that the emphasis we experience there is what the writer intended.

The moment we are made aware that closure is about to take place, it becomes crucially important for us to achieve it. To exemplify this need for closure, try singing the following and stopping when you get to the last word:

My country, 'tis of thee,
Sweet land of liberty,
Of thee I . . .

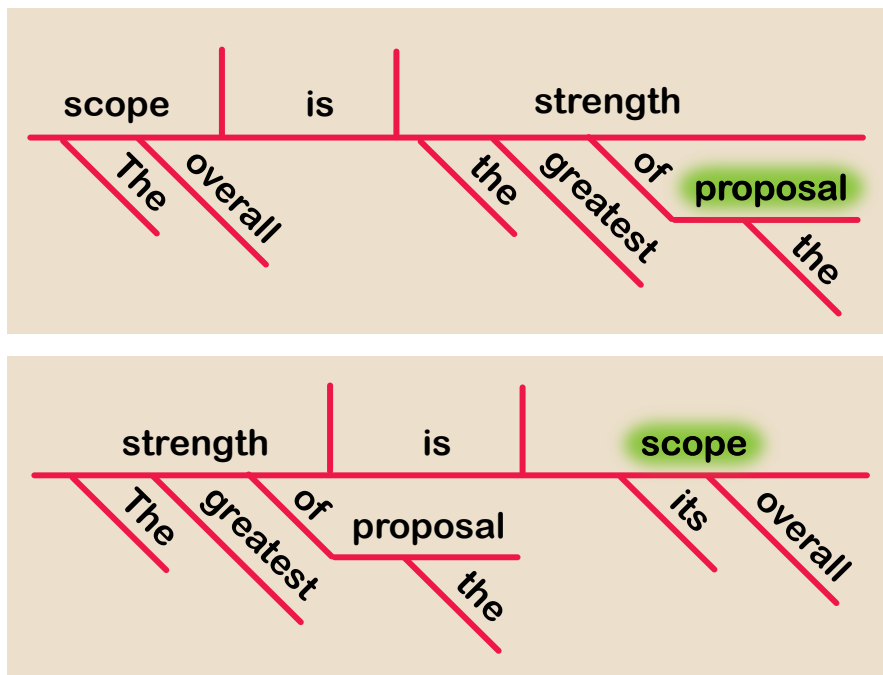
You are left there, hanging. Despite my instructions, did you find yourself moving forward to sing the last word and note? Did you feel something of a need to do so? What you wanted was closure—not only for the moment in the song, but for your task in the singing of it. That is what a stress position is—any moment of full syntactic closure. Or, to put it only slightly less technically, a stress position occurs whenever the grammatical structure of a sentence comes to a full close.

A stress position is created in part by the forward progress of grammar, in part by the beckoning of time, and in part by a motion one might call mu-

sical; but mainly it is created by expectation. The closer we come to the closure we are expecting, the more important it becomes both that we achieve that closure and that the emphasis we experience there be the one that the writer intended us to experience. Since readers are naturally going to give emphasis in a stress position, then writers ought to learn to locate in that stress position the information they most want the reader to stress.

In the past 22 years, dealing with more than 10,000 scientists one-on-one, I have encountered only two researchers who had no trace of a stress position problem.

What if, on a regular basis, you put the stress-worthy information elsewhere in the sentence? One of two things is likely to happen to your readers, and both are bad: Either, since the important information was not located in a stress position, readers may well have breezed right over it without stressing it; or they will stress, contrary to your intentions, the less important information that you allowed to occupy the stress position. If the first of these happens, your readers will become confused, even without being aware that it has happened. If the second happens, even worse, they will come away from the sentence convinced they have



Tom Dunne

To the writer, the two sentences diagrammed above might seem to convey the same meaning, but to the reader, the takeaway of each sentence is different because the word in the stress position (*highlighted in green*) has changed. In the top diagram, “scope” is the subject of the sentence, but readers will naturally emphasize the last word, “proposal,” because it occupies the stress position. In the second diagram, “scope” is in the stress position, which makes its importance clear and provides a natural flow to the next sentence, which would describe the scope.

succeeded in reading it as intended, but with the wrong meaning.

The definition of “quality” in writing is contained in the answer to this simple question: Did the reader get delivery of what the writer was trying to send? If the answer is “yes,” the writing was good enough; if the answer is “no,” it was not. And it matters little how impressive or dazzling the writing may have seemed to be along the way.

The worst writing in English does not cry aloud how burdensome it is. The worst writing seems harmless on first reading but completely fails to get the writer’s message across. If the reader did not get the message but thinks they did, they have no way of knowing they did not get the message. That is the worst writing.

Here is a 10-word example of no seeming difficulty, culled from a response to a grant application:

The overall scope is the greatest strength of the proposal.

What is the problem? There are no hard words. There is no passive construction. There are no grammatical errors. At 10 words, it is both shorter than the average sentence of a college freshman (13 to 15 words) and way

shorter than the average sentence of a practicing scientist (26 to 29 words).

The problem is that we, as readers, are unsure how the writer would like us to “perform” this sentence. Its stress position, created by the period, is occupied by “of the proposal.” The author told me this prepositional phrase, far from being the most important thing in the sentence by itself, was intended only to qualify “the greatest strength.”

Fine. But can we, as readers, be sure which of the remaining two candidates for the stress position—“overall scope” or “greatest strength”—was the one the writer wanted us to emphasize? Semantically, it is a hard choice. One candidate has “overall” in it; the other has “greatest.” To make sense of this sentence as the writer intended, the reader has to resort to guessing.

Let us take a guess and rewrite the sentence so that it emphasizes “greatest strength.” Pushing “of the proposal” to the left, we can thereby let “greatest strength” reap the benefit of the stress position:

The overall scope is the proposal’s greatest strength.

Can you hear how convincing it is that we should be emphasizing “the great-

est strength”? Can you hear how we are now leaning forward to learn yet more about that strength? Can you hear how the “overall scope” has the job of announcing whose “story” this sentence is meant to be? (We tend to read sentences as being the story of whoever or whatever shows up early on as the grammatical subject.)

What if the author now tells us that we guessed wrong? She really wanted us to emphasize “the overall scope.” What to do? Simple: Get “the overall scope” to the stress position:

The greatest strength of the proposal is its overall scope.

Once again, we can “hear” her intended emphasis. Once again, we are leaning forward to hear yet more about the stress position’s occupant. And now the sentence has become the story of “greatest strength.”

As simple, short, and seemingly unencumbered as this 10-word sentence is, it was badly written because only some of us would have come away from it guessing correctly as to what we should have emphasized. All of us would have had to put more reading energy into making that decision than we should have needed to expend. If this writer consistently puts the stress-worthy information in the middle of her sentences, her readers are consistently going to have to use too much reader energy to discern her intended meaning. Quite often, although they will come away from the sentence with what feels like a sufficient interpretation, they will have mistaken her meaning. By the end of reading her entire document, no wonder we might feel fatigued.

A Guessing Game

A second example increases in complexity just a bit, but with these matters, a bit can be a lot:

Platinum agents are the backbone of first-line chemotherapy for pancreatic cancer.

This time we have four units of information—one more than in the previous example. The stress position is filled with “for pancreatic cancer.” Is that the only term to which we should be giving emphasis?

Identifying the intended emphasis becomes in part a matter of music. If I were to read this sentence aloud, I could change its meaning by varying which words I choose to emphasize by

raising my voice. Here are four possibilities, with bold lettering indicating where I might raise my voice:

Platinum agents are the backbone of first-line chemotherapy **for pancreatic cancer.**

Platinum agents are the backbone **of first-line chemotherapy** for pancreatic cancer.

Platinum agents are **the backbone** of first-line chemotherapy for pancreatic cancer.

Platinum agents are the backbone of first-line chemotherapy for pancreatic cancer.

All four performances are reasonable; but only one of them can come closest to what the writer intended. And maybe none of them do: Maybe the writer intended us to stress two pieces of information. Why should the writer leave this important task of interpretation up to the reader? If the odds of our guessing correctly are this bad for a sentence that contains only 11 words, what will happen when we encounter a sentence with 35 or 59 words or more?

This is what the last two options above would look like if we moved the bold words to the stress position:

For first-line chemotherapy in the treating of pancreatic cancer, **platinum agents** are considered **the backbone.**

The backbone of first-line chemotherapy for pancreatic cancer is the use of **platinum agents.**

If you are trying to decide which of these two is the better choice, you are probably using the wrong organ of your body: the ear. We tend to judge the quality of prose mostly by its sound. Instead, we should be using the eye and the mind. Without knowledge of reader expectations, we are perhaps the worst judges of the efficacy of our own prose. We already know what we want the sentence to mean. When we read it, either silently or aloud, we know what to emphasize and will always get that right.

Actually, we as writers are not judging whether or not the sentence is good as it stands; instead, we are judging whether or not the sentence is merely *capable* of meaning what we want it to mean. That is insufficient. For the sentence to succeed, it must convince al-

most all of our readers to read it as we would read it to them. Knowing where readers expect the most important information to appear, we can judge our own prose by seeing whether the key point is located in the stress position. If the stress-worthy information is located in the stress position, almost all of our readers will understand what to stress.

The correct choice among the above revision attempts is the last one. How do I know that? Not because it sounds the best, but rather because the next sentence begins, "These agents target cancer cells . . ."

The backbone of first-line chemotherapy for pancreatic cancer ought to be the use of platinum agents. These agents target cancer cells . . .

The worst writing in English does not cry aloud how burdensome it is. The worst writing seems harmless on first reading but completely fails to get the writer's message across.

The main job of the first sentence was to introduce and highlight "platinum agents." That made it available to become whose story the next sentence was to be. None of the other above revisions could do that job as well.

As readers, not only do we need to read each sentence with confidence and accuracy, but we also need to move effortlessly from one sentence to the next without losing track of where we should be going.

Adding Stress Positions

These first two examples were seemingly simple, even simplistic sentences, but what we are starting to see is that a great percentage (I estimate around 85 percent) of the instructions the writer sends the reader for the interpretive process come not from word choice but rather from the sentence's structure. Where a piece of information shows up in a sentence will con-

trol how that information is used by most readers. The most important of all these many structural instructions is proffered by the stress position.

Let us take a look at a slightly more complex example:

This 12-month intervention examined the effect of adding parent training to a weight loss program including education on nutrition and physical activity compared to education alone, in 21 adolescents and young adults with Down syndrome.

Compared to our earlier, shorter examples, this 35-word sentence contains much more information. As a result, there are more potential candidates for emphasis. But this sentence still has only one stress position, at its end. It is highly unlikely that "Down syndrome" deserves stress here; it is almost certain that "Down syndrome" (even if it does deserve stress) would not be the sole piece of information deserving of emphasis.

In order for us to deal with this ambiguity, we have to develop further the possibilities for stress positions. The sentence includes a comma; but a comma cannot create a stress position. There are so many comma uses in English that we always have to read beyond the comma in order to understand its function in the sentence. Does it introduce a new clause, signal an interruption, or indicate that we have just read the first item in a list? Because we are required to read beyond the comma to find out what role it is playing in a sentence, it cannot provide the syntactic closure necessary to create a stress position.

However, there are other tools in English that generate closure and provide a stress position: the colon and the semicolon. (If you are among the many people who was never taught the full use of the colon and semicolon and find these punctuation marks intimidating, fear not: I have provided an explanation of these useful tools in the sidebar, "Demystifying Colons and Semicolons," on page 350.)

The author of this example told me that everything after the word "alone" was meant to be background information, merely contextual, and therefore not worthy of emphasis. He wanted us to stress three things: "parent training"; "education on nutrition"; and the combination of "physical activity" and "education." "Parent training" was meant

Demystifying Colons and Semicolons

Most of us were taught the uses of the colon inadequately, if at all. Very few of us were ever taught how to use the semicolon; as a result, we tend to shy away from using it at all. But the proper use of these two punctuation marks can help writers better control a reader's reading experience.

For both the colon and the semicolon, the grammatical rule states that what precedes those punctuation marks must be able to stand by itself as a complete sentence. By giving syntactic closure to the preceding main clause, the colon and semicolon are able to create a stress position in the middle of a sentence.



Tom Dunne

There are two main uses of the colon. The first (and more common) use is to announce to the reader that a list of examples will follow. Those examples may be, and usually are, sentence fragments. Since the colon creates a stress position, the reader can let go of the energy used to read that clause and summon fresh reader energy for dealing with the list of examples.

The second colon use is of great importance to the writer of anything sophisticated or complex: It announces that a whole new main clause (a full sentence equivalent) will appear for the purpose of restating or exemplifying what was said in the first clause. An example of this usage is the sentence you just finished reading. Think of this type of a colon almost like an equal sign.

When you begin a main clause after this second kind of colon, you would do well to start it with a capital letter. That practice will warn the reader to expect the structure and weight of a main clause. Aside from designating proper names or reducing a long term to an acronym, capital letters in Eng-

lish are usually used to signal a new sentence is beginning.

Main clause + colon + lower case letter = a list is coming.

Main clause + colon + capital letter = a new main clause is starting, which will restate what has already been said from a different perspective.

The semicolon is similar but subtly—and importantly—different. Like the colon, a semicolon requires that what precedes it must be a main clause. Like the colon, it therefore provides a stress position in the middle of the sentence. A semicolon tells the reader, “You have just completed a main clause and stressed the material at its end; but hold that thought in mind, since it is only part one of a two-part thought, the second part of which is starting now.” An example of this usage is the sentence you just finished reading.

Scientists are constantly faced with the necessity of putting two half-thoughts into a single sentence in order to demonstrate the vital relationship between two objects or ideas. The semicolon is a powerful tool in the hands of the scientist who knows how to use it. Without it, any sentence that reaches 25 words in length is likely to have stress-worthy material in its middle, rendering that material unable to benefit from a stress position. Once again, the reader will often be left having to do too much interpretive work in guessing the writer's intentions.

You might well ask, if few of us were ever taught how to use a semicolon, why should we presume our readers will understand what to do with it? The answer is simple: We all figured out for ourselves what to do with a semicolon the very first time we encountered one. We paused more than we would at a comma but less than at a period. It was too imposing a punctuation mark to be merely comma-ish; but since no capital letter followed it, it was not as finally final as a period. After all, a semicolon is merely a vertical stacking of a comma and a period.

to be an umbrella for the others. We therefore need to create stress positions for all three items. The contextualizing material has to be transported to the beginning of the sentence, where it can best create context. Here is the revision:

Taking for its subjects 21 adolescents and young adults with Down syndrome, this 12-month intervention examined the effect of adding to a weight loss program some significant parent education: That included both nutrition education by itself and a combination of education with physical activity.

The colon here acts both as a mid-sentence stress position and as an umbrella for the other two programs.

But how, you might ask, does “nutrition education” get stressed, being so far removed from the period? Well, in addition to the basic definition of stress position I gave you earlier (“any moment of full syntactic closure”), we also need a more cumbersome definition as to when the stress position begins. You know you are just beginning a stress position when you are correctly assured that there is nothing left in the sentence other than that which you are now beginning to read. That moment is a signal that you can start exhaling what is left of your breath of sentence energy.

For example: “After 12 blind-controlled experiments, with results conforming to our previous expectations, we can confidently state that (1)” Most readers will feel confident, when they see the “(1),” that all that is remaining in the sentence is this numbered list we are now beginning to read. The entire list, therefore, is in the stress position. Want to know how you can oppress your readers to the point that they will wish never to read any more of your writing? Just give them a long stress position like this list but give them no period. Give them a comma and keep on going. Destroy their expectation of being able soon to let this sentence go. Do this a lot, and by the end of the document you will leave them both fatigued and annoyed.

In the revised sentence at the top of this page, we see an example of how to stress two things in one stress position: All you have to do is announce that there will be two items to be stressed. That is done neatly by the word “both.” In a sentence structured

as “We will do this by both X and Y,” readers will stress the first item on an upbeat and the second on a downbeat.

Achieving Clarity

For our last example, let us look at a 59-word sentence—by no means the longest you will encounter in scientific writing, but long enough to make the point. As you read it, try to decide which words you should be stressing.

A comprehensive integrated approach has not yet been considered to the problem of identifying the cellular and molecular pathways of NCI resulting from chronic radiation-induced inflammation employing specific mouse models as proposed here using both WBI and partial CI techniques such as HSI to study brain areas associated with memory formation and other important cognitive faculties including executive functions.

This author has moved forward with a kind of linear logic; but his structure is fashioned by a method we could well describe as stream-of-consciousness. That might serve well for English literature, where multiple interpretations by multiple readers is considered praiseworthy; but for a piece of scientific writing to be considered praiseworthy, it should come close to meaning only one thing to all its readers.

Can we say this sentence is too long? We can; but we should define what we mean by “too long.” It has nothing to do with how many words the sentence contains. Here is a new definition for the term: A sentence is too long when it contains more viable candidates for stress positions than it has stress positions. When that is the case, we often get to a moment in the sentence when we think we might need to stress something but have no punctuation mark (colon, semicolon, or period) that invites us—instructs us—to invoke that sense of emphasis. When that happens multiple times in the same sentence, as in this example, our reading of that sentence leaves us both wearied and confused.

Occasionally, as in this case, separating a lengthy sentence into two sentences is one—but only one—of the possible remedies. Even then, each of these new sentences will still seem too long unless everything that requires stress has its own stress position. Once the author cleared up for me what

those stress-worthy pieces of information were, restructuring the whole was not very challenging. Here is his list of information for stress positions. How close does it come to the words you chose to emphasize?

chronic radiation-induced inflammation

HSI

memory formation

Here is the resulting revision:

As yet, there is no comprehensive, integrated approach to solving the problem of identifying either the cellular or molecular pathways of NCI resulting from chronic radiation-induced inflammation. Here we propose employing specific mouse models, using both WBI and partial CI techniques such as HSI; with these we can study brain areas associated with a number of important cognitive faculties, including numerous kinds of executive functions, but especially memory formation.

When readers come to trust that you will always provide a stress position for everything you are intending for them to stress, they will read more swiftly, more smoothly, and more confidently; this confidence, in turn, will greatly increase the likelihood of readers understanding what you intended them to understand. When they get consistently rewarded for stressing everything in your stress positions, they will cease to consider words located elsewhere as candidates for stress. You will have produced for them clarity.

In the competition for grant funding, for success in publication, and for power in all other professional communications, the constant use of a stress position to indicate emphasis and to provide closure is the single greatest secret of clear writing.

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