

## PARAGRAPH DEVELOPMENT IN SCIENTIFIC AND TECHNICAL WRITING

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**Abstract:** *A paragraph is a grouping of sentences, a way of carving them up into connected sets so as to reduce the diversity of their thoughts to manageable proportions. Normally readers will expect a paragraph to have a single focus and one role since it is defined as a group of sentences developing a single idea, concept, thought, and topic. Overlong paragraphs, with too many sentences in them, have numerous drawbacks. The text becomes under organized and difficult to follow. However, paragraphs should not be too short. If paragraphs are reduced to just one or two sentences, then they cease to have this organizing rationale and become heteronymous cogs, turning as the argument progresses but not doing any useful work. For English-speaking readers, short paragraphs in technical writing will also make the text look disconnected, fragmented, and uncertain. A paragraph's pattern is important in making an argument look coherent and well organized because it is a unit of thought. In general, a paragraph should make one point, or one component part of a single broader point. Where a paragraph handles miscellaneous unconnected points, as it is sometimes necessary to round out an argument, this role should be explicitly signaled to readers because they will not expect it. The relationship between the ideas in an EST (English for Science and Technology) paragraph and between the items of information and the core generalization is expressed by several techniques. Sometimes the nature of the material the writer has available determines the applied technique, but at other times, the writer makes his own decisions as to the best way of presenting the relationships between his ideas. In the first case, we are dealing with natural techniques, and in the second, with logical techniques, and they are not mutually exclusive.*

**Key words:** paragraph development, English for Science and Technology, natural techniques, logical techniques.

### 1. INTRODUCTION

A paragraph is a unit of thought. In English writing, much more than in many other languages, the pattern of paragraphs is a very critical element in making an argument look coherent and well organized. In general, a paragraph should make one point, or one component part of a single broader point. Where a paragraph handles miscellaneous unconnected points, as is sometimes necessary to round out an argument, this role should be explicitly signaled to readers because they will not expect it (Jones, 2007). Normally, readers will expect a paragraph to have a single focus and one role. Overlong paragraphs, with too many sentences in them, have numerous drawbacks. The text becomes disorganized and difficult to follow (Bahtia, 1998). But paragraphs should not become too short either. A paragraph is not a sentence. It is a grouping of sentences, a way of carving them up into connected sets so as to reduce the diversity of the thoughts to manageable proportions. If paragraphs are reduced to just one or two sentences, then they cease to have this organizing rationale and become heteronymous cogs, turning as the argument progresses but not doing any useful work. For English-speaking readers, short paragraphs in academic work will also make the work look disconnected, fragmented, and uncertain (Hartley, Sotto & Fox, 2004). The author will appear to be casting around for what to say, starting to make points but then not properly developing them.

The optimal length for paragraphs varies a great deal from one kind of writing to another. Professional academic work is always configured for printing as books or journal articles. Here, the printed page typically holds around 500 words. The ideal length for paragraphs is one that divides each page several times. A good starting point is at around 150 words. But paragraph lengths of between 100 and 200 words are perfectly acceptable.

The paragraph, as the basic concept in scientific and technical writing, consists of a *core generalization* followed by supporting information that develops this generalization to the extent the author feels is necessary (Murray & Moore, 2006). This supporting information can be made up of other generalizations on various levels of abstraction or details, or a mixture of the two. However, whether the paragraph is deductive (proceeding from core to support) or inductive (proceeding from support to core) or is a mixture of these two, the same rhetorical elements are found in the development of the paragraph

(Jordan, 2005). The same principles also apply to the larger units of communication: the subsection, the section, and the entire text.

### 1.1 The concept of conceptual/physical paragraph correspondence

A paragraph is typically defined as a group of sentences that develop a single idea (concept, thought, and topic) and are distinguished from other paragraphs on a page of text by spacing and/or indentation; thus, *conceptual and physical paragraphs* can be discussed. (Chandler, 1995).

*The conceptual paragraph* can be redefined as a group of organizationally (rhetorically) related concepts which develop a given core generalization in such a way as to form a coherent and complete unit of discourse. This conceptual paragraph is the basic unit of discourse in EST (English for Science and Technology) writing. If the writer develops his core generalization in one physical paragraph, then the physical and conceptual paragraphs are the same and there is a one-to-one correspondence between them. If, on the other hand, the information in the conceptual paragraph is presented in two or more physical paragraphs (which is most often the case when the core generalization is divisible into parts), then there is one-to-more-than-one correspondence (Brooks & Warren, 1992). When more than one *physical paragraph* is used to develop the core generalization of the conceptual paragraph, each physical paragraph usually has its own "sub-core". Thus, each has a lower level generalization which, while supporting the major generalization, at the same time provides the subject for the particular group of sentences making up the physical paragraph (Elbow, 2000).

## 2. PARAGRAPH DEVELOPMENT RHETORICAL TECHNIQUES

The relationships between the ideas in an EST (English for Science and Technology) paragraph and between the items of information and the core generalization are expressed by several techniques. Sometimes the nature of the material the writer has available determines the technique (or techniques) he will use; at other times, the writer makes his own decisions as to the best way of presenting the relationships between his ideas. In the first case, we are dealing with *natural techniques*; in the second, we are dealing with *logical techniques* (Day & Gastel, 2006). For example, if the writer has some material that requires a chronology, he will present it by using *time order*. This type of material may be historical or it may be a process description, thus requiring events to take place one after another in a given series. Or the writer may have to present the physical structure of something—for example, a machine, a building, or an electrical circuit. In this case, his material will require him to show the physical relationships of the parts to one another in terms of their relative positions. Then, he will have to use the technique of *spatial order*. Again, if he is faced with a process description or any discussion that employs a step-by-step development in which the various phases of operation are functionally related, he will need to use *cause and effect* to show how one activity affects one or more following activities. These three techniques: time, space, and cause and effect, are called the *natural orders* because the nature of the material determines the choice the writer should make. It should be noted that they are not mutually exclusive. All of them can be employed in a given paragraph (Herbert, 2008). However, one will usually dominate.

If, on the other hand, the material is of such a nature that the writer has freedom of choice, then other factors enter into the technique(s) he will use. For example, if he wishes to inform his reader by relating something the reader knows to the subject under discussion, then the writer can choose the technique of *comparison, contrast, or analogy*. If he wishes to exemplify, he can choose the technique of *example*, or present his explanation in a detailed example, usually called an *illustration by words*. If he chooses to relate his discussion to a visual aid, he is then using the technique of *illustration*. Or he may deliberately choose to present his information in causal terms, even though the nature of the material does not demand it. In this case, he is using the technique of *cause and effect*. These techniques chosen by the writer are called *logical techniques*. Again, they are not mutually exclusive.

The important factor in relation to reading comprehension is for the reader to become aware of the core generalization of the paragraph. That is:

1. What does the paragraph refer to?
2. What subject is being discussed?
3. What is the paragraph's purpose?

The reader should also be aware of the nature of the core, whether it is a single statement or one that has two or more parts (Herbert, 2008). If the latter, the reader should be alerted to the possibility that more than one physical paragraph will make up the total paragraph — the conceptual paragraph — that is developing the core generalization. Having determined the core generalization, the reader should be aware of the technique or techniques the writer is using to develop the information that supports the core. These techniques are usually marked by words—as a rule, adverbs or prepositions.

## 2.1 Time order

There are two types of *time* development of a paragraph (Hayes, 2006).

*Time chronology*, in which the writer shows events taking place one after the other in clock or calendar time; that is, the writer traces the development of something through history or over a shorter period of elapsed time. In this type of development, the terms that indicate the time pattern are usually dates (calendar time) or hours, minutes, etc. (clock time). In some paragraphs, a time period (the 18th century, for example) will be set and the events being described will fall within that period. In these cases, the key words such as *first*, *second*, etc. are used.

*Time process*, the second type of time development in the paragraph, is concerned with the steps in a procedure or process. The term "process" can be defined as a series of two or more steps in which each step but the first is related to the preceding step; that is, a definite order of activity should be followed. Terms indicating time processes are often *first*, *second*, etc. or *now*, *then*, *after*, etc. The time process, by the very nature of the material, is usually combined with *cause and effect* in that one step will be the cause, with its effect being the following step.

## 2.2 Spatial Order

The order of the components in a descriptive essay should correspond to their spatial locations or other relevant factors. The perspective and perception of details by the reader are influenced by the structural sequence of descriptive paragraphs. Place is emphasized, while time is disregarded. It is the rhetorical technique the writer uses when he wants to show the reader how objects are related spatially to one another. It is especially common in giving physical descriptions (Hayes, 2006).

Common *spatial order* words are: *in*, *out*, *up*, *down*, *above*, *below* (any adverb of place or position); *first*, *second*, *last*, *next*, *following...* Besides, there is a common use of appropriate verbs to describe the spatial order of certain procedures.

## 2.3 Cause and effect

Information in a text is frequently organized using the cause-and-effect model. Cause and effect essays give the explanations for why something occurred or its results. Cause-and-effect text structures are frequently utilized in persuasive and explanatory writing styles (Hayes, 2006). When a writer provides explanations for why something occurred, they are describing what created an effect (reasons are causes, and the thing that happens is the effect). Additionally, when a writer discusses the outcomes of an activity, they are discussing the impacts of a cause (since outcomes are effects and causes are things that happen). Because cause-and-effect text structures are so ubiquitous, it's likely that we have written a paragraph with one without realizing it.

It is used to show a causal relationship between things or ideas, etc. It is very common in technical writing. It is indicated by the terms: *because*, *thus*, *hence*, *therefore*, *so that*, *such that*, *due to*, *as*, *since*, *as a result of...*

## 2.4 Examples

Examples are used to give the reader a specific case (or a general one) of the generalization represented by the core idea. This rhetorical technique is denoted by terms *such as*, *as can be seen*, *as an example...*

A representative is something that exemplifies the entire group. The knowledge the audience already possess is used to help them learn something they do not know. Creative and captivating examples illustrate the points (Hayes, 2006).

## 2.5 Visual illustration

Words and illustrations can be combined in various different ways. Good readers can envision what they are reading in their minds. When reading technical writing, drawings can aid readers in picturing the settings, and events that take place. In addition to assisting readers in visualizing what the text is describing, illustrations can also aid in word comprehension. In addition, the illustrator's choice of medium can help convey an appropriate tone for the text.

It is used when the writer wants to make his point clear by referring the reader to a picture, a graph or any other visual aid. This is often used as a kind of example. Terms which indicate this technique are: *as figure n indicates (shows, illustrates, explains) as can be seen in figure n ....; see figure n....*

## 2.6 Verbal illustration

A good visual illustration is not an excuse for a poor presentation. And often, a concept is too abstract to be represented visually. So, this is when we use *verbal illustrations*. An example used by a speaker to evoke in the listener a vivid mental picture that best conveys the speaker's message is known as a verbal illustration (Graham, 2006). It is used when the writer wants to give the reader a very specific, detailed example. Terms which indicate this rhetorical technique are: *an illustration is, by way of illustration...*

## 2.7 Comparison and contrast

This structure emphasizes the similarities between things, happenings, or people through comparison and the differences between things or happenings through contrast. This format is typically used in technical writing. Writing in this format gives the author the opportunity to cite specific instances that support their point of view, which could be biased. A Venn diagram is a popular graphic organizer for students to use to separate and arrange their ideas (Graham, 2006). When comparing, writers that use this pattern may use words like *alike, similarly*, or both. Writers may employ contrastive words like *opposite, however, or while*.

They are used to make a difficult concept easier to grasp by comparing or contrasting it to something already known to the reader; or they are used to state the opposite of what might be expected from a preceding statement. Terms that indicate these techniques are: *in comparison, in contrast, on the other hand, however, although, nevertheless, but, in spite of ...*

## 2.8 Order of importance

It is a rhetorical technique used when a series of supporting details should be put in some order. This order can be from the least to the most important, or more commonly in technical writing, from the most to the least important. Common terms that indicate this technique are: *first, second, most important, least important, last, in the order of importance ...*

The writer or speaker assigns ideas or actions a ranking in accordance with a hierarchy of values. Information can be arranged from most important to least important or from least important to most important when adopting the order of importance pattern of organization. Both text structures would be regarded as having equal relevance (Hayes, 2006).

## 2.9 Details

It is customary in technical writing to give specifics, details, and concise descriptions or explanations of unknown concepts. Even if the audience is comprised of experts, if we use a specific phrase or detail that is not frequently used, it should be defined clearly.

Details are used when simple supporting statements for the core idea of the paragraph are needed, often in descending order of importance. Details can be presented in *cause and effect, comparison or contrast, time, space*, and other rhetorical techniques. A common type of detail is statistical data (Hayes, 2006).

## 2.10 Analogy

It is a rhetorical technique used when the writer wants to make a comparison of things which are basically not alike. Comparison compares things that are basically similar, but analogy compares things that are basically dissimilar. Terms indicating this rhetorical technique are: *by way of analogy, analogically, by analogy...*

Analogies have two types: correspondences and inferences. The first type of analogy is a relationship between two otherwise unrelated items. If we want to compare a notion to another one that our audience is familiar with, a structure, connection, or purpose that is comparable to the concept we are defining should be considered. Analogies are used especially when we are unable to come up with any common examples of the topic since it is so strange.

The second kind of analogy assumes that if two objects are similar in some ways, then they must also be similar in other ways. For instance, we can argue that if raising tuition at institutions in our country made it more difficult for foreign students to attend, raising tuition at private colleges would have a similar effect (Graham, 2006).

### 3. CONCLUSION

The technical paragraph in its simplest and most common form begins with or has near the beginning a core idea—a generalization that tells the reader what the paragraph is about. Then this core is developed by one or a combination of the methods given above. By the writer's using the key terms listed, the reader is told what type (or types) of development is being used, and therefore the reader can understand the information given to him more quickly and more clearly. Which types of development are chosen by the writer should be determined by the writer's analysis of the problem.

(1) Which type (or types) best expresses this core for the purpose for which the paragraph is written, and

(2) Which type (or types) is best suited to a specific reader (or group of readers)? A reader with little background knowledge needs a simpler presentation than a more knowledgeable reader.

A technical paragraph basically makes some kind of statement, and then it proves that statement or provides the reader with further information in some way. Also, it is a unit of organization for the material that makes up the entire piece of writing.

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