On paragraph building

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1. Introduction: What a paragraph is

What do paragraphs do? They each develop a single idea in more detail, and do so in a coherent way using cohesive language. The latter is achieved using suitable sentences construction and topic sentences. A very simple example of this is the paragraph you are currently reading. Another example is shown below:

> In the discipline of statistics, the mean is one form of average among three and is what is called *a measure of central tendency*. Means are calculated on the basis of the simple arithmetic of adding up all the data values and then dividing this sum by the number of data values. The term "central tendency" refers to the fact that the mean lies right at the centre, or middle, of the set of data and that, because of this, the data has a tendency to collect(equally) around the average.

Notice that the text above consists of compound/complex sentences. Also,

- the first sentence (lines 1-2) is a topic sentence. It is a topic sentence which introduces the idea of the mean, and the collective compound noun for this (i.e. "measure of central tendency");
- the second sentence develops the idea of the man further by explaining how this is calculated;
- the third sentence then explains the linguistic meaning of the term "measure of central tendency". This, again, is an element of detail which can be said to be relevant to the topic of the paragraph as a whole.

That's it. There is really nothing more to say about the nature of individual paragraphs. At this stage it is then simply a matter of analysing many example paragraphs in order to understand how well written/developed they are, and then practice writing your own well-developed individual paragraphs. However, we don't just write individual paragraphs but multiple paragraphs, and extended writing is not simply a collection of individual paragraphs. So we now look at how to write multiple paragraphs in a coherent and cohesive manner.

2. Paragraph building and cohesion: Building paragraphs cohesively

Sections of extended writing contain multiple paragraphs (just as in these notes or in textbooks or in academic papers or other). The aim, when writing multiple paragraphs, is to allow us to introduce different ideas or aspect of the scientific phenomenon, and do so in a fluid and smooth manner from one idea to the next, from one level of detail to the next, both in terms of linguistic cohesion and scientific coherence. Integrating different individual aspects of a scientific phenomenon into a coherent and cohesive whole is what ends up making a section a self-contained unit of writing.

We have already dealt with aspects of linguistic cohesion and scientific coherence in a previous lesson. Here we will go through examples of cohesion as it relates to paragraph building via language. In section 3 we will go through examples of coherence as this relates to paragraph building as it relates to scientific ideas.

2.1. Transitioning from one idea to a new idea

One of the more important aspects of building multiple paragraphs is to move, or transition, between ideas. This allows us to present different aspect of an idea and develop each aspect as a separate paragraph *whilst using language to show the degree of linkage or difference between the aspects escribed separately in each paragraph.* Refer back to the notes of lesson 1.4 as needed.

As such, consider the following example (which is my own piece of writing):

> In the discipline of statistics, the mean is what is called *a measure of central tendency*. The mean is a way of calculating the average value of data based on simple arithmetic. This is achieved by adding up all the data and diving by the number of data values. The term "central tendency" refers to the fact that the mean lies right at the centre, or middle, of the set of data.
>
> There is also another way of finding the average value of data values, namely that of the median. Here the median relies of ordering the data from smallest to largest and then identifying the middle value. This middle value is a form of average because it represents the value that is most likely.
>
> Focusing more closely on the nature of data itself, we find that there are data values called outliers. Outliers can be defined as data values which lie significantly outside the main trend of the data. A single outlier in a data set can significantly

15 change the value of the mean compared to the mean calculated without the outlier.
16 On the other hand, the median is not affected by outliers. When data is arranged in
17 order the middle data values remains in the middle, irrespective of how large or small the outlier is.

Analysis

In order to identify transitions we initially need to analyse the first paragraph. Only then will we know in the second paragraph if a transition has occurred. So, for the first paragraph we see:

- Lines 1-2: The first sentence is a topic sentence setting the scene for the rest of the paragraph. The first sentence introduces the theme of measure of central tendency, of which the mean is one type. Note also that the first part of the sentence, "In the discipline of statistics", can be called a topic phrase because this describes more broadly the discipline within which means and measure of central tendencies are located. Remember that topic sentences describe ideas more generally and broadly than subsequent sentences so that "In the discipline of statistics" can be seen as a more general description to "the mean is what is called *a measure of central tendency*".
- Lines 2-4: The second sentence onwards should focus on some detail of means or measures of central tendencies. This it does in the second and third sentences, by explaining how the mean is actually calculated (this is the detail).
- Lines 4-5: The last sentence of this paragraph then returns to the other idea stated in the topic sentence by explaining the wording "central tendency". So this sentence does indeed belong to this paragraph

For the second paragraph we can now focus on transition, if any. In fact, there is a transition. Notice the language used to effect this:

- Line 7: Firstly, notice that the first sentence of line 7 is a topic sentence because it describes the content of the second paragraph in a generalist manner. Then notice the phrasing "There is also another way of". This allows me to change from discussing the mean (as in the first paragraph) to discussing the median, now.
- Lines 7-10: having set up the topic sentence of the paragraph I then proceed to develop the idea of the median in more detail. Do you agree that this is what I have done?

Notice, however that I am still talking about averages in the second paragraph (as I was in the first paragraph). This means that this second paragraph should/does come in the same section (which we will assume it does).

For the third paragraph, because it is a new paragraph, we can now focus again on transition, if any. In fact, there is a transition. Notice the language used to effect this:

- Lines 12-13: Yet another topic sentence starts this paragraph. However, I am now moving completely away from the idea of measures of central tendencies and towards a completely new idea of data known as outliers. This shift in focus is effected by the language "Focusing more closely on the nature of data itself". Notice here that I have not used one word or a collocation but a phrase in order to show transition. The rest of the paragraph then elaborates the detail of what outliers are, and their effect on the mean and median

  Notice that within this paragraph there is another transition. This is effected by "On the other hand" (line 16). Transitions can happen within a paragraph (not just between paragraphs) provided the subsequent description still address the topic of the paragraph. Here it does because the topic of the paragraph is about outliers, and I first talk about the effect of outliers on the mean, and then talk about the effect outliers on the median.

Alternative transition phrasing

Each of the three transition phrasings or sentences could have been written in other ways. Examples are shown below. Remember that if you use any one of these examples you will need to rewrite the rest of the sentence appropriately:

- "There is also another way of":
  - "There is an alternative way in which we can";
  - "The median is another measure of central tendency different from the mean, this being the median."
  - "Sometimes it is useful to find an alternative form of average value, this being known as the median."
  - "A second measure of central tendency is known as the median."

- "Focusing more closely on the nature of data itself". Here I will have to rewrite the whole of the topic sentence for paragraph 3:
    - "Important to the effect on measures of central tendencies are data values known as outliers.";
    - "However, particular consideration needs to be given to particular data values known as outliers.";
    - "Measures of central tendencies are not immune to certain problems. For example, the mean …", then continue to introduce the idea of outliers.
    - "In the previous paragraph we spoke the way the mean was calculated. There is a situation with respect to the data used to calculate the mean which adversely affects the mean.", then continue to introduce the idea of outliers.
    - "Despite the benefits of the mean, it has a significant drawback.", then continue to introduce the idea of outliers.
    - "Although the mean has many advantages in statistics, it has a significant drawback.", then continue to introduce the idea of outliers.
- "On the other hand, the median is not affected by outliers.":
    - "Although the mean is affected by outliers, the median is not.";
    - "In contrast to the mean, the median is not affected by outliers.";
    - "It is important to note, however, that the median is not affected by outliers.";
    - An obvious replacement for "On the other hand" at the beginning of a sentence is "However".

2.2. Signposting what is to come

Signposting refers to indicating to the reader what is to come in the text. This helps the reader know if you are continuing to focus on a topic but focusing on more detail, or whether you are going to change to a different aspect of the topic, or whether you are going to give an example, etc… In other words, signposting forewarns the reader in a change in the emphasis of what you are focusing on in the text. Refer back to the notes of lesson 1.4 as needed.

As an example, consider the text below.

In this section we consider what is known as *a measure of central tendency*, and the consequences to such measures resulting from the type of data we might have. One measure of central tendency is the mean. This is a way of calculating the average value of data based on simple arithmetic. This is achieved by adding up all the data

and diving by the number of data values. The term “central tendency” refers to the fact that the mean lies right at the centre, or middle, of the set of data.

Having established the mean as one measure of central tendency we now move onto considering another way of finding the average value of data values, namely that of the median. Here the median relies of ordering the data from smallest to largest and then identifying the middle value. This middle value is a form of average because it represents the value that is most likely.

Up to this point we have focused on the averages of the data. We now need to consider a specific aspect of the data itself, this being what is known as outliers. Outliers can be defined as data values which lie significantly outside the main trend of the data. A single outlier in a data set can significantly change the value of the mean compared to the mean calculated without the outlier. On the other hand, the median is not affected by outliers. When data is arranged in order the middle data values remains in the middle, irrespective of how large or small the outlier is.

Analysis

- Lines 1-2: This is a topic sentence with “In this section” acting as signposting to what the whole section of writing (not just this paragraph) will address. The idea referred to by this signpost is “measure of central tendency”.
- Lines 2-3: In terms of paragraph development notice that the second sentence present more detail by stating one specific type of measure of central tendency.
- Lines 3-5: The third and fourth sentences continue on the idea of the mean by describing even more detail, namely how one actually calculates the mean.
- Lines 5-6: Finally, the last sentence gives detail to what the term “measure of central tendency” means linguistically.

- Lines 8-10: This is again a topic sentence, but this time at a greater level of detail than that of line 1. This is ok since we are now onto the second paragraph which is going to elaborate on another measure of central tendency.

  Notice now a specific phrasing within the sentence “Having established the mean as one measure of central tendency we now move onto”. This phrasing is “we now move onto” and acts as signposting. This is telling us that we are now going to focus on

something different. But given that this paragraph is still part of the general topic of measures of central tendency, this new focus should also be a measure of central tendency. This is indeed the case since median are such measures.

- lines 10-12: Here we see that the median is discussed in more detail, as befits a second and subsequent sentence of a paragraph.

- Line 14-15: The second sentence is a topic sentence which acts as signposting. Along with the first sentence lines 14-15 acts as transition text (transition from averages to outliers).

  The rest of the paragraph (lines 16-20) act to elaborate on the nature o outliers by giving a definition and then explain the effect of outliers on the mean and the median.

Alternative signposting phrasing

Each of the signposting phrasings or sentences could have been written in other ways. Examples are shown below. Remember that if you use any one of these examples you will need to rewrite the rest of the sentence appropriately:

- "In this section we consider":
  - "Consider the problem of finding averages. One type of average is the mean which is more generally known as";
  - "The aim of this section is to";
  - "The main focus of this section is to";
- "we now move onto":
  - "In addition to the mean there is another measure of central tendency this being";
  - "However, the mean is not the only measure of central tendency. Another measure is"
  - "We now move onto considering another measure of central t4endency this being";
  - "Alternatively we may find the average by what is known as the median";
  - "There is also another way of": Notice that this phrasing acts not only as transition phrasing (see section 2.1) but also as signposting.

- "Having addressed the role of averages we now move onto considering":
    - "One aspect we have not considered above is that of outlying data";
    - "we now need to take account of a particular feature of data, namely";
    - "Focusing more closely on the nature of data itself": Notice that this phrasing acts not only as transition phrasing (see section 2.1) but also as signposting.

Other signposting language includes what might be called standard phrasing, as illustrated in the table below. This type of phrasing is seen a lot in writing.

We will show that …	Consider the following …	For instance,	Furthermore,
For example,	In particular, …	Conversely,	On the other hand,
As previously mentioned …	As an example, consider, …	Nevertheless,	Contrary to …
However, not all research shows that... Some evidence agrees that ...		The strength of such an approach is that …	By performing /analysing/… we will show/demonstrate/… that

2.3. Referring back to what has been said

It is often useful to have language which allows us to refer back to what we have previously written without having to repeat or summarise what we have previously written. Such language is known as *referencing* (not to be confused with the referencing of sources).

The usual and most common type of referencing is known as *anaphoric referencing*. This simply means that a text refers back to something stated previously. For example, "John is 32 today. He had a birthday party". Here, "he" refers back to "John". Such referencing may informally be called "backward referencing".

Alternatively, we can use what might informally be called "forward referencing". This is when we use a sentence that refers to something without first saying what that "something" is. It is only in the second, or subsequent, sentence that we state what that "something" is. For example, "He was 32 today and had to work. Despite this John still decided to take the day off". Such referencing is technically called *cataphoric referencing*.

Referencing is very useful as a linguistic device because it makes it more easy for the reader to carry meaning across multiple sentences. It also makes for a smoother/lighter style of writing, and therefore pleasure of reading.

As an example, consider the text below.

Although there are three methods for calculating averages of a data sets this section focuses on only two of them, these being the mean and the median. Such methods are collectively known as *measures of central tendency*. When using either one of these methods one also has to take into account a certain characteristic of the data itself, since this characteristic may unduly influence the value of the average. More on this later.

Returning to the idea of the mean this is calculated on the basis of simple arithmetic. It is found simply by adding up all the data and diving by the number of data values. The term "central tendency" refers to the fact that the mean lies right at the centre, or middle, of the set of data.

When it comes to finding average by way of the median we rely on ordering the data from smallest to largest and then identifying the middle value. This middle value is a form of average because it represents the value that is most likely.

It was previously mentioned that a certain characteristic of the data may or may not unduly influence the value of the average. Such a characteristic is known as an outlier. Outliers can be defined as data values which lie significantly outside the main distribution of the data. They are usually identified as being very large or very small values compared to other data values.

In the case of the mean, outliers significantly influence where the middle of the data is located. In that case, the mean will not be representative of the middle of the data. In the case of the median, the middle data value remains in the middle, irrespective of how large or small the outlier is, because such an outlier doesn't lie in the middle but at the ends of the data set.

Analysis

- Lines 1-3: This is a topic sentence since it refers to three methods of finding averages and the two that will be discussed. We know this is a topic sentence because the second, third, and fourth paragraph discuss these two methods in more detail.
  Also, the phrase "Although there are three methods for calculating averages" in line 1 is a forward (cataphoric) reference to the specific methods stated in line 3, i.e. the mean and the median.
  Note that there is also a signposting phrasing in this sentence, this being "this section focuses only on …"

- Line 4: The wording "These methods" acts as a backward (anaphoric) reference to the mean and the median.

- Line 5: The wording "this characteristic" acts as a backward (anaphoric) reference to "a certain characteristic" of line 4.

- Line 6-7: The wording "More on this later" acts as a forward (cataphoric) reference. This tells us that a later section of text will discuss this characteristic in more detail. *If this is the case then, when time comes for me to write on this detail, I will need language to remind the reader that I am picking up on something I mentioned way back in the text.* Note also that "More on this" acts as signposting.

- Line 8: As for "More on this later" so the wording "Returning to the idea of" acts as both signposting and backward (anaphoric) referencing. It also acts as transition because I ended the last paragraph on the idea of "a certain characteristic". If I don't signpost and transition I won't be able to address the idea of the mean, which is what I want to do for the second paragraph. Note that I didn't have to talk about the mean in paragraph two. I could have talked about "the certain characteristic". But if I had done so the last sentence of paragraph one, i.e. "More on this later" would not make sense, and should not have been written.

- Line 9: The word "It" is backward (anaphoric) reference to how one calculates the mean.

- Line 13: The wording "When it comes to" is a subtle form of signposting, particularly when read in conjunction with the rest of the sentence which refers to the median. The rest of the paragraph then details how the median is found. There is no referencing in "When it comes to". I simply mention it because of its subtlety, and the fact that we haven't seen this before.

- Line 17: The wording “It was previously mentioned that” acts as a backward (anaphoric) reference to “the characteristic” mentioned in the first paragraph. It also acts as signposting (telling us what we are now going to talk about) and transition (away from talking about how averages are calculated”. The paragraph then goes on to give details about this characteristic, namely outliers.
- Lines 23-27: Exercise: Can you find any referencing in this paragraph? If so, which type is it (forward or backward)? Also, are there occasions for signposting and/or transitioning in this paragraph?

Note that we can also reference the work of others, i.e. “Smith (2000) has proved that …” This is an backward reference to previous work done by someone else. We will see more of this when we do the lesson on literature review.

Alternative referencing phrasing

Each of the referencing wording or phrasings could have been written in other ways. Examples are shown below. Remember that if you use any one of these examples you will need to rewrite the rest of the sentence appropriately:

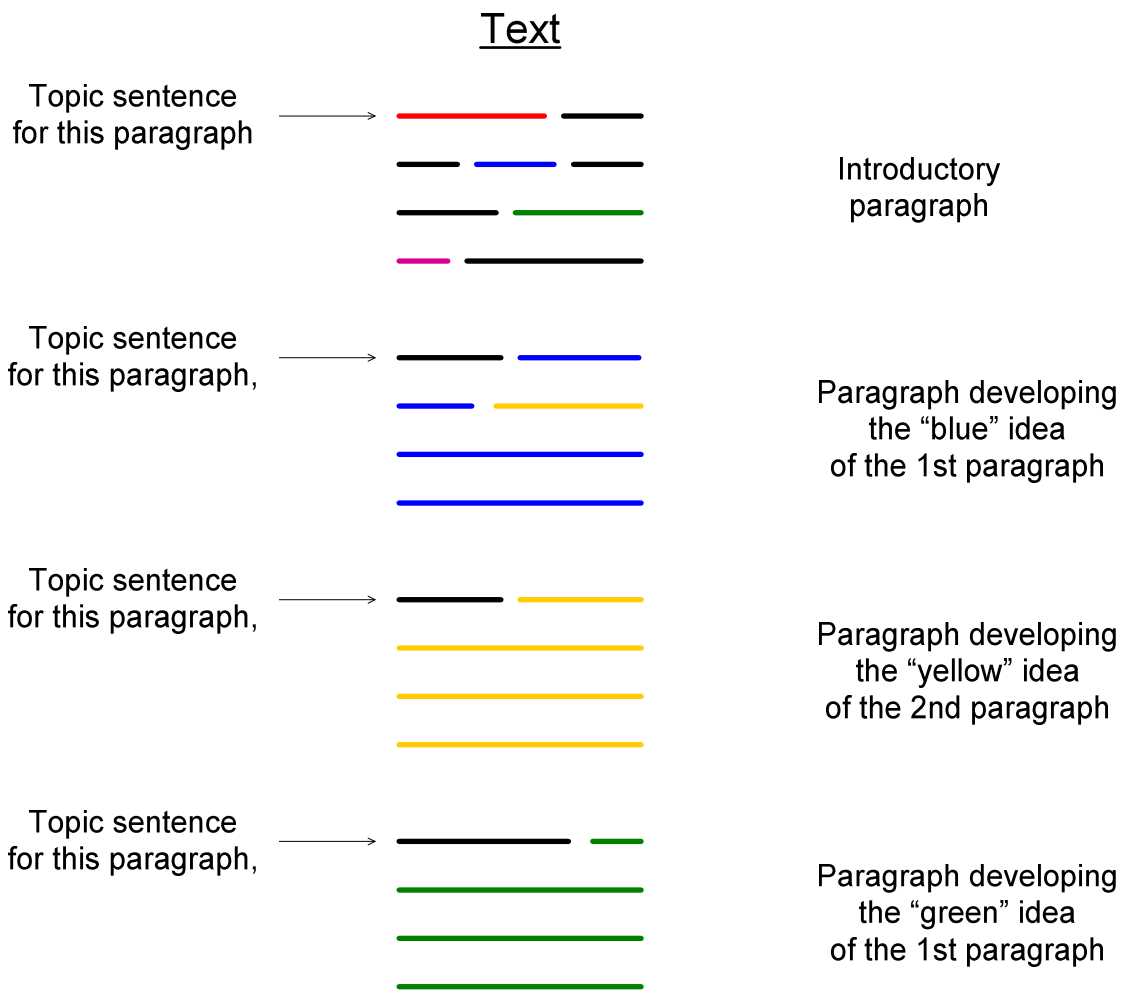
- “Although there are three methods for calculating averages of a data sets this section focuses on only two of them”
    - “Even though there are three methods for calculating averages of a data sets we will focus on only two of them”.
    - “Whilst there are three methods for calculating averages of a data sets we will focus on only two of them”.
- “Returning to the idea of the mean”
    - “Picking up on the idea of the mean”.
    - “Addressing the idea of the mean previously mentioned”.
    - “Coming back to the idea of the mean mentioned earlier”.
- “a certain characteristic … this characteristic … More on this later”:
    - “a certain characteristic, as we shall see later”.
    - “a certain characteristic, to be discussed in paragraph 5”.
    - “a certain characteristic, to be discussed shortly”.
- “It was previously mentioned that a certain characteristic of”:
    - “As mentioned earlier, a certain characteristic of”.
    - “As stated previously, a certain characteristic of”.

2.4. Important note

We haven't been able to cover all versions of transition, signposting, and referencing phrasing. There are far too many forms of language that can be classified under any of these three categories. This point of these sections, and this set of notes as a whole, is to show you the basic forms of linguistic cohesion relating to these three categories. Once you have understood this you can then go on to reading multiple papers to see how different authors write cohesively using these categories.

2.5. A diagrammatic summary of this section

The diagram below is an illustrative example of how to build multiple paragraphs in a scientifically coherent manner. Note that this illustration is simply a representation of how to develop coherence of one's scientific ideas. It is not intended to show the actual structure you should use in your own writing (although you may end up having such a structure). Write for meaning and to express yourself. Then structure your meaning/expression. Don't write for structure, and then force meaning into your structure.



2.6. An example of developing a paragraph from a topic sentence

When one writes a topic sentence to a paragraph one tends to know what idea one wants to develop in more detail. This development becomes the rest of the paragraph. Depending on its content we could develop the scientific idea stated in the topic sentence in many different directions. For example, if my topic sentence is:

Many courses utilise the notion of least squares line of best fit,

I could either expound upon the idea of "courses" or of "least squares line of best fit" or of something else. I could therefore write

1) *an alternative approach to the standard way of deriving the relevant equations:*
   "Many courses utilise the notion of least squares line of best fit. The usual way of deriving the least squares line is straight forward for students who have a basic knowledge of calculus. Here we present a simple analytic geometry approach as an alternative way of deriving these equations."

or

2) *an alternative to using the mean as the measure of centre:*
   "Many courses utilise the notion of least squares line of best fit. This is based on the idea of deviations from the mean data value. But this approach makes the line of best fit sensitive to outliers. In this article we show how basing the least squares analysis on the median produces a line of best fit which is more robust."

   The following two examples are alternative to transitioning from the third sentence to the fourth sentence:

   - "Recognising this vulnerability, we introduce an alternative method that eliminates the flaw inherent when using the mean",

   or

   - "Since this method has a weakness, another way of fitting a line through data is to base the fit on the median of the data. This article shows how this approach produces a line of best fit which is more robust."

or

3) *a general statement about the idea behind lines of best fit:*
   "Many courses utilise the notion of least squares line of best fit. The method is an algebraic technique for fitting linear equations to experimental data. Since experimental data never all lie on a single straight line the aim of the technique is to find the "best" straight line which passes through the data."

or

4) *a historical account of how least squares analysis developed:*

"Many courses utilise the notion of least squares line of best fit. The first clear and concise account of the method of least squares was by Legendre in 1805. Within ten years after Legendre's publication the method of least squares was adopted as a standard tool in astronomy in France and Italy."

or

5) *a definition of least squares:*

"Many courses utilise the notion of least squares line of best fit. The line of best fit is one which passes through the mean of the data and minimises the distance between the line and all other data points. It also optimises the gradient of the line"

or

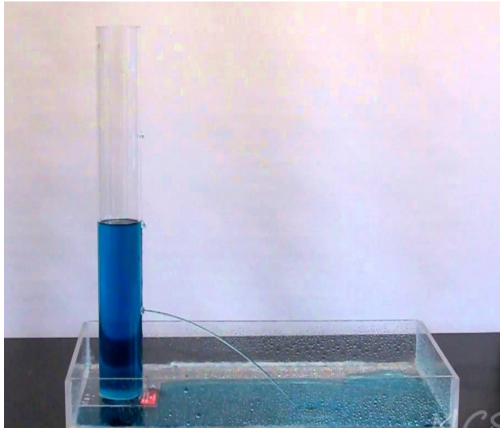
6) *a critique*:

"Many courses utilise the notion of least squares line of best fit. The standard approach to least squares analysis uses the mean as its basis. However, this is known to not be robust since the analysis based on the mean is sensitive to outlying values. As a result, many authors have adopted the use of …"

From these examples we should get a sense that there is a symbiotic link between the idea expressed in the introductory sentence of a paragraph and the way the idea is developed in the rest of the paragraph.

3. Paragraph building and coherence: On developing scientific ideas coherently

We have just seen how to develop cohesiveness between paragraphs. Now we go through developing one's scientific ideas coherently. To this end we will go through several examples, all related to the scientific idea of studying liquid flow through holes. This comes under the physics topic of Torricelli's law, and is illustrated by the photo below.



Example 1

Let us start with the following topic sentence:

> "Many studies have been conducted on liquid flow through holes."

This sentence is so broad that it could be classed as the first sentence of the first paragraph of a section. Then, in terms of a coherent development of the topic, where do we go from here? One way to illustrate the possibilities is via what I call a *coherence structure diagram*, where the possible scientific ideas are written in red:

Coherence structure diagram

Water flow through holes

- |---> Theoretical study via mathematical models?
- |--> Experimental set-up?
- |---> Practical applications in industry?
- |---> Environmental issues relating to experiment
- |---> Cylinder?
- |--> Other idea?

Other idea?

Example 2

It is up to us to decide how to continue the topic. Therefore, consider the sentence of example 1 continued as shown below:

> "Many studies have been conducted on liquid flow through holes. The usual experimental arrangement for such studies are …"

So we have decided to focus on the aspect of the experimental set-up of studies on liquid flow through holes.

Coherence structure diagram

Water flow through holes

- |---> Theoretical study via mathematical models
- **|--> Experimental set-up**
- |---> Practical applications in industry
- |---> Environmental issues relating to experiment

|---> Cylinder?

|--> Other idea?

Other idea?

In terms of a further coherent development of the topic, where do we go from here?

Example 3

Continuing to develop the topic as we choose, we arrive at the description below:

> *Ex 3.1:* "Many studies have been conducted on liquid flow through holes. The usual experimental arrangement for such studies *has involved cylinders*."

So our focus on the experimental set-up relating to studies on liquid flow through holes has now centred on the apparatus of a cylinder. Or we could have written

> *Ex 3.2:* "Many studies have been conducted on liquid flow through holes. Experimental arrangements have been set up so as to model/mimic *real-world applications such as those used in industry.*

So our focus on the experimental set-up relates to how this mimics the real world.

The coherence diagram for Ex 3.1 might be as illustrated below:

Coherence structure diagram

Water flow through holes

|---> Theoretical study via mathematical models

|--> Experimental set-up

|---> Cylinder

|---> **Practical applications in industry**

|---> Environmental issues relating to experiment

|---> Cylinder?

|--> Other idea?

Other idea?

What would the coherence diagram for Ex 3.2 look like? In terms of a further coherent development of the topic, where do we go from here? Some possibilities are written in red:

Where next?

Water flow through holes

|---> Theoretical study via mathematical models?

|--> Experimental set-up

|---> **Cylinder**

|----> different vertical configurations of cylinder?

|----> different sized holes?

|----> different types of liquids used?

|---> **Practical applications in industry**

|---> Environmental issues relating to experiment>

|--> Other idea?

Other idea?

Example 4

Continuing with the text of Ex 3.1 above we might continue to develop the topic as below:

> "Many studies have been conducted on liquid flow through holes. The usual experimental arrangement for such studies has involved vertical cylinders with holes of *different sizes and height*."

So our focus on the experimental set-up has now centred not only on cylinders but also on holes. The coherence diagram for this might be as illustrated below:

Coherence structure diagram

Water flow through holes

|---> Mathematical model

|---> Practical applications in industry

|---> Environmental issues relating to experiment

|--> Experimental set-up

|---> **Cylinder**

|----> vertical configurations of **cylinder**

|----> different hole configurations in **cylinder**

In terms of a further coherent development of the topic, where do we go from here? Some possibilities are written in red:

Where next?

Water flow through holes

- |---> Mathematical model?
- |---> Practical applications in industry?
- |---> Environmental issues relating to experiment?
- **|-->** **Experimental set-up**
  - |---> **Cylinder**
    - |----> different vertical configurations of **cylinder**
    - |----> different hole configurations in **cylinder**
    - |--> different dimension used for cylinders?
    - |--> Other idea?
  - |--> Liquids used?
  - |--> Assumptions made?
  - |--> Other idea?

Other idea?

Example 5

Continuing to develop the topic as we choose, we arrive at the description below:

> "Many studies have been conducted on liquid flow through holes. The usual experimental arrangement for such studies has involved vertical cylinders with holes of different configurations, along with different liquids.

So our focus on the experimental set-up has now centred not only on cylinders and holes, but on their configuration on the cylinder. The coherence structure diagram for this might be as illustrated below:

Coherence structure diagram

Water flow through holes

- |---> Mathematical model
- |---> Practical applications in industry
- |---> Environmental issues relating to experiment
- **|-->** **Experimental set-up**
  - |---> **Cylinder**
    - |----> **different vertical configurations of cylinder**
    - |----> **different hole configurations in cylinder**
    - |--> different dimension used for cylinders
  - |--> **types of liquids used.**
  - |--> Assumptions made

So

- The more depth/detail you add to your idea the more you strengthen you focus on that idea. This implies a degree of conceptual coherence to your writing;
- The less depth/detail you add to your idea the easier it is to choose which other idea you want to focus on, or the easier it is to change direction and move from one idea to another.

In terms of a further coherent development of the topic, where do we go from here? One way to illustrate the possibilities of this is shown below:

Where next?

Water flow through holes

|---> Mathematical model?

|---> Practical applications in industry?

|---> Environmental issues relating to experiment?

|--> Experimental set-up

|---> **Cylinder**

|----> different vertical configurations of **cylinder**

|----> different hole configurations in **cylinder**

|--> different dimension used for cylinders?

|--> Other idea?

|--> Liquids used in the **cylinder**.

|--> Assumptions made?

|--> Other idea?

Example 6

Continuing to develop the topic as we choose, we arrive at the description below:

> "Many studies have been conducted on liquid flow through holes. The usual *experimental arrangement* for such studies has involved cylinders and holes of different configurations along with different liquids. For example, the *temperature* and *pressure* of the *experimental environment* can greatly influence the flow-rate of water."

Our focus, which was on the experimental set-up centred on the configuration of cylinders and holes, has now shifted to the idea of temperature and pressure. What makes this problematic writing is the use of "For example" at the beginning of the third sentence. This

type of start to a sentence will automatically lead the reader to expect a continuation of the ideas previously stated. I.e. they would expect to read more about cylinders, holes and their configuration. But out-of-the-blue we are presented with the concept of temperature and pressure. We can therefore say that there is a break in the coherence of this paragraph.

Example 7

The more you move away from one idea (or aspect of an idea) and towards another idea (or aspect of the idea) the less coherent you are with respect the former aspect. If you suddenly address a completely different change ideas within the middle of a paragraph you are very likely to have made that paragraph scientifically incoherent.

Note that it is possible to introduce a new idea or aspect (seemingly) out-of-the-blue, but this should be done in a new section, or in a new paragraph with suitable language/linguistic features (such as transition language or signposting). If this new aspect is to coherently fit into the discussion of your central idea, the new section should be written in such a way as to conceptually (and linguistically) link back to relevant previous aspects of that idea.

As such, it is possible to make coherent the text of example 6, two versions of which are illustrated below:

> *Version 1*
>
> "Many studies have been conducted on liquid flow through holes. *The usual experimental arrangement for such studies* has involved cylinders and holes of different configurations along with different liquids.
>
> *Other aspects considered in such studies* have included the effect of temperature and pressure due to the experimental environment, this greatly influencing the flow-rate of liquids under study."
>
> *Version 2*
>
> "Many studies have been conducted on liquid flow through holes. The usual experimental arrangement for such studies has involved cylinders and holes of different configurations along with different liquids. *For example*, the cylinder could be of small, medium or large diameter, as well as being vertical or slanted, and/or the holes could be of different sizes, and be located at different positions along the height of the cylinder."

The coherence diagrams for these texts are as follows:

Coherence structure diagram for version 1

Water flow through holes

- |---> Mathematical model
- |---> Practical applications in industry
- **|-->** **Experimental set-up**
  - **|--->** **Cylinder**
    - |----> different vertical configurations of cylinder
    - |----> different hole configurations in cylinder
    - |--> liquids used in the cylinder.
  - |--> Assumptions made
- **|--->** **Environmental issues relating to experiment**
  - **|-->** **temperature and pressure effects**
    - |--> influence on flow-rate
    - |--> Other idea
  - |--> Other idea
- |--> Other idea

Other idea

Coherence structure diagram for version 2

Water flow through holes

- |---> Mathematical model.
- |---> Practical applications in industry.
- |---> Environmental issues relating to experiment.
- **|-->** **Experimental set-up**
  - **|--->** **Cylinder**
    - |----> different **vertical configurations of cylinder**
      - |--> **specific examples of** dimensions and configurations of cylinders.
      - |----> different **hole configurations in cylinder.**
      - |--> **specific examples of** sizes and location of holes.
    - |--> Liquids used in the cylinder.
  - |--> Assumptions made.
  - |--> Other idea.
- |--> Other idea.

Other idea.

Concluding comment

1) Be sure to re-read "Important comment1" and "Important Comment 2" in the green boxes of the notes of lesson 1.4.

2) All academic essays or papers deal with only one key, central idea which is then developed in more detail via its differing aspects. In your writing you should therefore aim to link these aspects back to each other (where appropriate), back to your central idea (directly or indirectly) in a conceptually and linguistically coherent manner, and back to your thesis. By doing this, the interrelatedness of the separate aspects will be seen more clearly, both conceptually via the logical way in which you develop the connection between aspects, and linguistically via your use of English and discipline specific language.

Both linguistic and scientific conceptual coherence are required if your text is going to be easy to read, and support the reader in understanding the meaning of the technical ideas you are presenting. Therefore, this requires you to develop fluency and mastery of the content of your discipline as well as in the English language and discourse of your discipline.

4. Exercises: Texts from the literature

In class we will, as a group, choose one or two of the texts below. Then, analyse your chosen texts according to i) paragraph building, ii) topic sentences, iii) transitions, iv) signposting, and v) referencing.

4.1. Example 1: Chemistry

The following text is taken from Özmen (2004). We will analyse this during the lesson.

> "Chemical bonding is one of the most important topics in undergraduate chemistry and the topic involves the use of a variety of models varying from simple analogical models to sophisticated abstract models possessing considerable mathematical complexity (Coll and Taylor, 2002; Coll and Treagust, 2003; Fensham, 1975). It is also a topic that students' commonly find problematic and develop a wide range of misconceptions. The concepts of electron, ionization energy, electronegativity, bonding, geometry, molecular structure, and stability are central to much of chemistry, from reactivity in organic chemistry to spectroscopy in analytical chemistry (Nicoll, 2001). And also, it is important for students to grasp these concepts in understanding why

and how chemical bonds occur. Chemical bonding has been classified into a series of three target systems; metallic, ionic, and covalent bonding."

4.2. Example 2: Mechanical Engineering – Vibrations

The following text is from Liew, Xiang, and Kitipornchai, S., (1995). We will analyse this during the lesson.

"Mindlin et al. [41] investigated the free flexural vibration of rectangular Mindlin plates with simply supported edge conditions and with one pair of parallel edges free and the other pair simply supported. Analytical solutions for these plates were obtained. They found that three independent families of modes are possible when the plate edges are simply supported. The coupling of the modes has also been studied for the case of one pair of parallel edges free and the other pair simply supported."

4.3. Example 3: Physics

The following text is taken from Franklin (2004). The analysis of this text is shown immediately afterwards.

One of the interesting problems concerning experimental results is what happens when an experiment gives a null result, when the phenomenon expected is not observed. Is it because the experimental apparatus and the associated analysis procedures cannot detect or measure the phenomenon in question or is it because the phenomenon is not present? This is a real problem in the practice of physics. In the Michelson-Morley experiment, one of the most famous experiments in modern physics, the experimenters expected to detect a fringe shift caused by the motion of the earth relative to the ether. They found no such fringe shift. Was it because the apparatus was faulty or because the earth's velocity relative to the ether was zero?

Analysis

- Lines 1-3: This is a very general statement, particularly the phrasing "One of the interesting problems". This first sentence is therefore a topic sentence (as the first sentence of a paragraph should be), and particularly with respect to the rest of the paragraph which provides more detail on the subject of this first sentence.

Notice that, in line 2, that “when an experiment” is not referencing language, but that “when the experiment” (had this wording been used) would be referencing language. This is because of the use of the definite article “the” which always refers to one specific experiment previously alluded to.

In that case, the wording “when the phenomenon” is referencing language but what does it refer back to? There is no prior mention of a phenomenon in the text. However, this is not a problem since the reference relates to common knowledge about the discipline, namely that experiments are always about studying “a phenomenon”.

- Lines 3-5: Both words “it” in “is it” are backward (anaphoric) references since they refer to obtaining null results as mentioned in lines 1-3.
- Line 5: Similarly, “This” is a backward (anaphoric) reference refer to obtaining null results, and makes sense in the context of the phrasing “This is a real problem”.

  We can see that lines 3-5 (the second and third sentences) develop specific reasons (issues of apparatus, analysis or presence of phenomenon) relating to the general topic of the topic sentence (i.e. problematic issues of obtain null results).
- Lines 5-8: Here we see a transition to a particular example, but without the use of transition language such as “For example”. Remember what transition language does, so that a lack of transition language can cause a jarring effect to the reader since a change of topic has not been forewarned. The lack of transition need not be a problem if one knows how to write. In this case what the authors have chosen as their example an experiment which is famously known for producing a null result. I would then say that any initial jarring is obviated by the knowledge of the results of this experiment. The rest of the sentence then describes the specifics of the null result.

  There is then referencing in the sentence “They found no such” of line 8. The word “they” refers to Michelson and Morley, and “such” refers to “the motion of the earth relative to the ether”.

4.4. Example 4: Statistics

Consider the following text taken from Wasserstein, Schirm & Lazar (2019). The analysis of this text is shown immediately afterwards.

> The *ASA Statement on P-Values and Statistical Significance* stopped just short of recommending that declarations of "statistical significance" be abandoned. We take that step here. We conclude, based on our review of the articles in this special issue and the broader literature, that it is time to stop using the term "statistically significant" entirely.
>
> […]
>
> Regardless of whether it was ever useful, a declaration of "statistical significance" has today become meaningless. Made broadly known by Fisher's use of the phrase (1925), Edgeworth's (1885) original intention for statistical significance was simply as a tool to indicate when a result warrants further scrutiny. But that idea has been irretrievably lost. Statistical significance was never meant to imply scientific importance, and the confusion of the two was decried soon after its widespread use (Boring 1919).

<u>*Analysis*</u>

- Lines 1-3: The first sentence reads very much as focusing specifically on a particular aspect of a topic (the abandonment of the idea of statistical significance) rather than on being general in nature. Does this mean that this is not a topic sentence? No. To me it reads more as the topic sentence of a second or subsequent paragraph of a text (such topic sentences can be more specific). This is then clearly seen by the second sentence which picks-up on the omission stated in the first sentence.
- Lines 3-5: The wording "We conclude" acts as a type of referencing language since their conclusion relates to the idea (statistical significance) mentioned previously. Also, the wording "this", as in "this special issue", is referencing the journal the paper was published in.
- Lines 7-8: Here we start a new paragraph. The first sentence is again a topic sentence, this time acting as a transition. This is seen by the rest of the paragraph no longer talking about the idea of abandonment but now talking about the idea of misuse and misunderstanding of the nature of statistical significance. Lines 9-13 shows us this change in focus by describing what the original meaning of statistical significance was

supposed to be. How do the achieve this shift in focus? They do this via the phrasing "Regardless of whether it was ever useful …" of sentence 4.

- Line 10: The word "that" acts as referencing the idea of the previous sentence ("statistical significance was simply as a tool to indicate when a result warrants further scrutiny").
- Line 12: the words "its" acts as referencing. *Question*: What does "its" refer to?

A comment might be in order about the phrasing "Regardless of whether it was ever useful …" in line 7. Nowhere in the previous paragraph do the authors refer to the usefulness of statistical significance. However, this idea that statistical significance is useful can be inferred from the way it is used and taught in the discipline of statistics (any 1st year undergraduate book on statistics include statistical significance as a major section). Remember that the text above comes from a journal paper, this being aimed at an expert audience. So, the authors know that their readers are aware of the common usage of statistical significance. So, the phrasing "Regardless of whether it was ever useful …" actually refers back not to any previous paragraph of their paper but to the general usage in statistics.

5. Some criteria for a good paragraph

5.1. Comment 1

Paragraph building applies to every section you write: abstract, introduction, literature review, methodology, data collection, results and analysis, discussion, conclusion, etc. It also applies to whatever style you write: description, explanation, critique, argumentation, etc. In general we can state four criteria which orient us towards writing a good paragraph:

1. *Use of topic/introductory sentences*: We have seen examples of these already;
2. *Adequate development*: Elaborating on an idea to a sufficient degree of detail. We have seen examples of this in our answers to the two exercises above;
3. *Coherence*: This relates to the logical order of sentences which allows the idea to be developed in a unified manner. We have seen examples of this in our answers to the two exercises above.

   Paragraphs are incoherent either because we are not using language efficiently or correctly, or because we are trying to link several ideas which are conceptually quite different from each other.

We have seen examples of this in the example and exercise above, where the original collection of sentences where not in any kind of logical or meaningful order.

4. *Unity:* This relates to how the *concept* of one or more ideas are developed. A text which has unity can be seen by the way it clearly links or associates relevant concepts. Writing in such a way clearly show how an idea is being developed. We have seen examples of this in our answers to the two exercises above.

   Paragraphs don't have unity when there is too large a jump in the concept we are writing about. In other words, we can't see how two descriptions of an idea are related. The reason this can occur is if i) we are talking about two different ideas in the same paragraph, in which case we should split the paragraph into two separate paragraphs, or ii) we haven't given enough detail, or used language well enough, to make the first idea flow into the (seemingly different) second idea.

It is possible to go against these criteria. We can choose to write paragraphs that "break" some of these rules, but this requires a lot of experience in writing. This is when writing becomes an art rather than just a technique. But, ultimately, such a paragraph still has to read coherently and with unity of ideas in terms of the topic it is trying to expound upon.

Ultimately any segment of text, whether sentence, paragraph, section, etc. has to be traceable back to the underlying idea, concept, theme, and to the thesis of the paper, otherwise such a segment is not relevant to the topic we wish to expound upon.

5.2. Comment 2

By looking at as many examples as possible we can come to see aspects of a paragraph which makes it coherent:

1. It is useful for the first sentence of a paragraph to be a topic sentence;
2. There is certain key vocabulary and phrasing which allows us to develop coherence in the language/discourse of the paragraph;
3. The language of a paragraph should be used to carry and further develop the scientific, mathematical ideas, examples, concepts, etc.

So a paragraph serves to give the reader more substance to an idea of a particular section of the text. In other words, we might say that

Paragraph building =
The coherent development of an idea, using cohesive language and linguistic features (such as continuation, transitioning, signposting, referencing, etc.) where the paragraph has a specific focus and a sufficient degree of detail.

6. References

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