Research Methodology
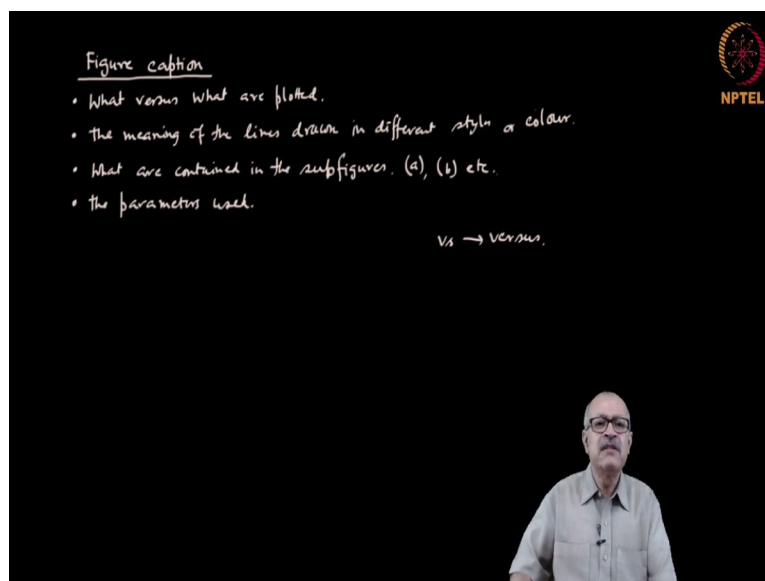**Prof. Soumitro Banerjee**
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Lecture - 60
Scientific Writing: Journal Papers Part 4

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Every figure has a caption. Normally you have to produce the figure in such a way that, it is more or less self contained, which means that, in order to understand the figure, whatever is needed should be contained in the caption itself, so that one does not have to read the whole paper to understand a particular figure.

This is because, as I said, readers jump around. Before reading the whole of the paper one might look at a particular image, particular picture, particular figure. And then it should not be so that the one cannot understand the figure without reading the main text. So, the figure caption should contain the following things.

What versus what are plotted. That is obvious. That has to be written: what versus what is plotted. And then, if you have used different line styles or different colours in different lines in the graph, then you have to say which colour means what, which line style means what, the meaning of the lines drawn in different styles or colour. Now the third thing that you have to mention is that, if a figure contains say four sub-figures, then what are contained in the sub-figures? That means, you have to say that figure 9(a) is this, figure

9(b) is that. That way, each part its subfigure has to be explained, that means, you have to say like (a), (b), etc. Then the caption should contain some detail about the conditions in which the figure is obtained, like the parameters.

So, the information that is necessary to understand the figure, these should be contained in the figure caption, and the parameters are one such information that are necessary to understand the figure. If you have written the parameter values in the caption, it is not necessary to repeat that in the main body of the text. One information should be in one place only. So, these are normally the things that need to be in the figure caption.

Just one word of advice: do not use vs to mean versus. You simply say 'versus'. So, x versus y, write the full form. That looks better.

Now, one important thing about figures is that, nowadays we normally produce figures in colour. This is fine so long as it is reproduced as well as read on the web and on the computer screen. But often journals have a print version also along with the online version, and the print version normally is in black and white.

If you want your paper to be printed in colour, then you have to pay, and often we avoid that. Therefore, while creating the pictures, we have to be careful. If somebody is reading in black and white, that can happen due to two possibilities, one is somebody is reading the journal in print form, the other is that one has got it on the web, but ultimately many people prefer to print it and read it from the print rather than from the screen. So, when one is printing and reading from the print, normally one would use a black and white printer and therefore, the writer has to be very careful to ensure that the right information is contained in the black and white image also. That is why, if you are to plot different graphs, use different line styles, maybe the firm line style, the dashed, the dash dot, and things like that, so that, even in the black and white image, one can easily distinguish between them. If we use different colours for different lines, then you have to tell the reader that if you do not understand what these differences are, please look at the paper on a computer screen.
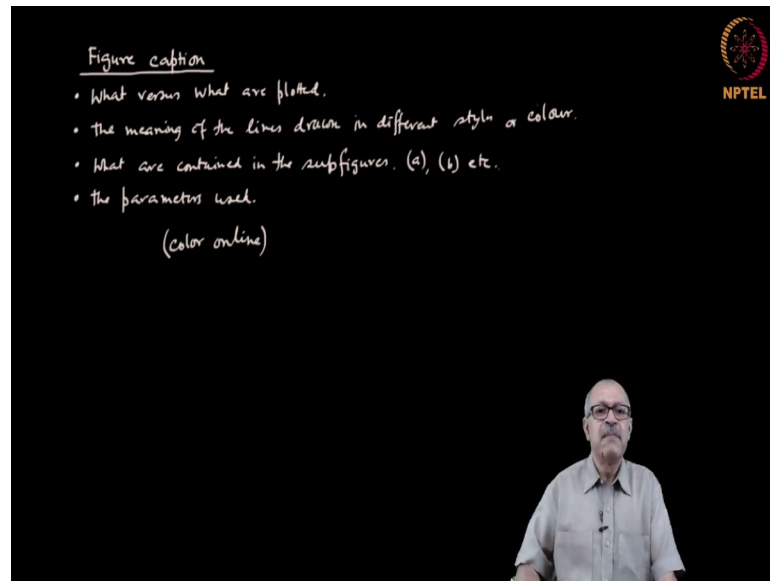
And so, one normally writes 'color online'. This is what we write in the caption itself, so that the reader knows that there is a colored version available. So, if I do not understand something then I can refer to that colored version. This is something that we put in brackets, so that they the reader knows. This is regarding the use of colors.

Now, when you are using a color picture in which different graphs are drawn in different colors, then make sure that when reproduced in black and white or printed in black and white, they have different gray scales, so that the reader can distinguish between them from the gray scale itself. How to do that? After preparing your paper you just print it in black and white, and see whether you can distinguish between the different lines or not.

If you can, then it's fine. If you cannot, then you have to use different colors. Different colors have different hues and that is why they produce different black and white images. So, one has to be careful about this fact that some people will read it in black and white and some people read it in color, and the writer has to be has to be alive to that possibility. So, writing has to be in that way.

One common mistake that many people make is to create the figures in enormous size. If you are using some program to produce this image, sometimes programs put in very unnecessary information in that image file like, for example, printer specific font information which is not necessary at all. But these will be used if you happen to print it

only by that printer. So, these are unnecessary increase in file size, and one is to deliberately avoid that.

The other situation where one produces enormous file sizes is, where one is trying to plot a much larger number of points than the resolution of the screen or the resolution of any printer. Normally the resolution of the screen or a printer would be 300 dots per inch. If you are trying to plot even more than that, then it would be useless, because two points will fall on the same place. They will not be distinguishable either on the screen or on print, and therefore, there is no point in even trying to do that.

So, one has to be careful. The reason that I am advising you to create the file sizes as small as possible is that, nowadays the situation has changed. Most people read on the go, most people read online, most people even read papers on the mobile phones. If it takes a long time—a large file size would mean that it would take a long time to download it, store it—and then you are read by less number of people.

So, it makes sense to try to create smaller file sizes containing the same information. I am not asking you to provide less information in the file. I am only asking you to avoid making file sizes that are more than what is really necessary to convey that information. So, this is regarding figures. So, far about the figures which are very important components of a paper.

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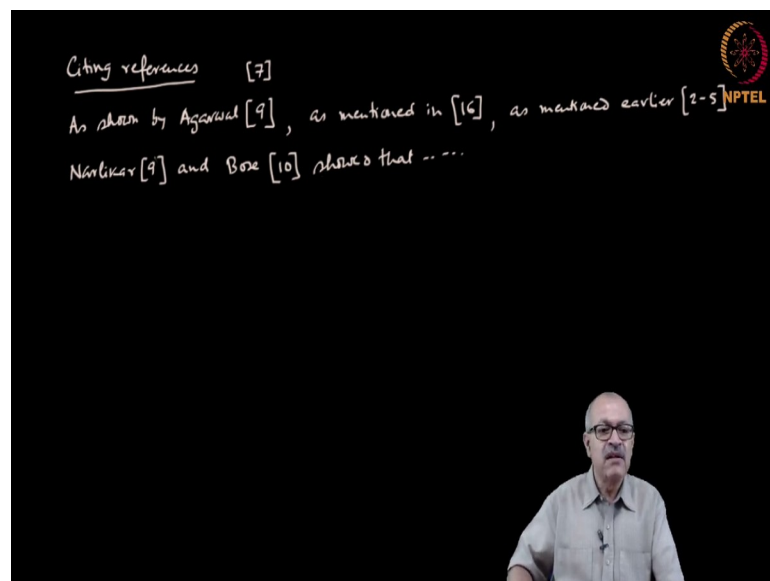
Now let us come to how to cite references? Normally, the references are cited in square brackets. Earlier people used to put these in superscript, but nowadays the universal practice is to use square brackets. But the citation in the square bracket should be treated as part of a sentence.

It is like, say, 'as shown by …' (somebody), or 'as mentioned in …', here we have put the name and then the reference. This is also perfectly fine: 'as mentioned in [16]'. Or, 'as mentioned earlier', then you put say [2] to [5]. So, that means, in reference [2] to [5] as mentioned earlier.

You notice that these become part of the sentence, 'as mentioned in something', that something is this, or 'as mentioned earlier' is a complete package, but then you put the reference so that it becomes clear to the reader what you are talking about.

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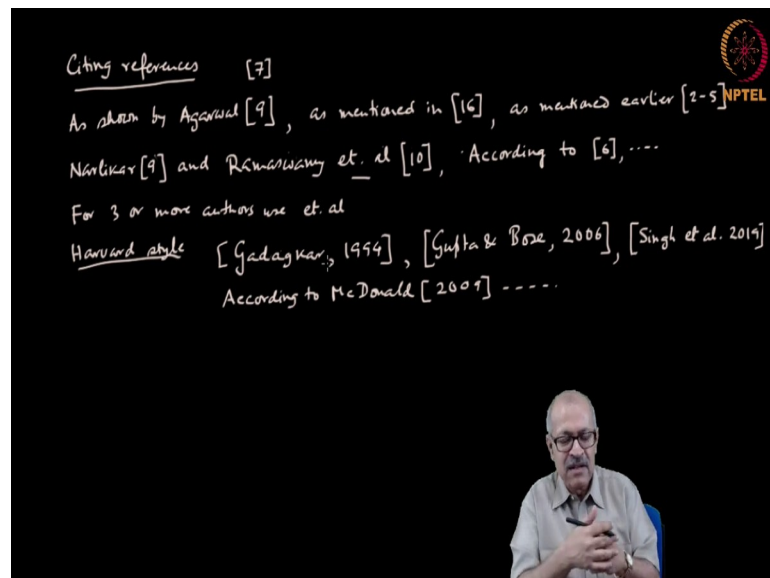
And sometimes we do cite as, this is another way of writing, where we are using the names, and then the references, or we can also write like 'Ramaswamy et al. [10]'. So these are different ways of citing a reference, or you can also write [6]. So, according to [6], according to what is written in reference [6]. So, these are ways of putting references in the literature survey.

Now, you might ask when to use 'et al.'. Sometimes we are using names, and sometimes you are using et al. The general convention is that, if there is one author, write the

author's name. If there are two authors, write 'Bose and Ramaswamy' -- that way. But if there are 3 or more number of authors, then the first author, et al. (and others). So, for 3 or more authors, use et al. This is the standard way of writing this.

Now this way of writing, where you are putting numbers in square brackets, this convention is followed in some journals, in fact most journals, while some other journals follow what is known as the Harvard style. In Harvard style it is basically the surname, and then surname of the authors, year of publication, put the whole thing in square bracket.

This is how we normally write the whole thing in square bracket. You say 'as shown by [Gadagkar, 1994]'. Then the person would look at the reference in the list of references in the name Gadagkar and in the year 1994. This is another way of writing. This will become a part of the sentence, and sometimes when you are using the name as a part of the sentence then the name goes out of the bracket and only the year of publication remains in the bracket. Like, 'according to McDonald' then within bracket the year. This is the Harvard style of citations.

Now, which one you would use depends on which journal you are submitting it to. Depending on the journal, you will have to tune it accordingly. Latex offers a very simple way of handling this, because if you have prepared it for one journal and then decide to submit to another journal, then you have to make all those changes. Latex makes it easy to do that, because there how it will ultimately appear, depends on the citation style used by the journal. When you download the style files from the journal website that includes it. So, if you compose it using that style file, it automatically composes according to the journal's own style.

That is why, most people nowadays prefer Latex; especially scientific papers are typed in Latex.
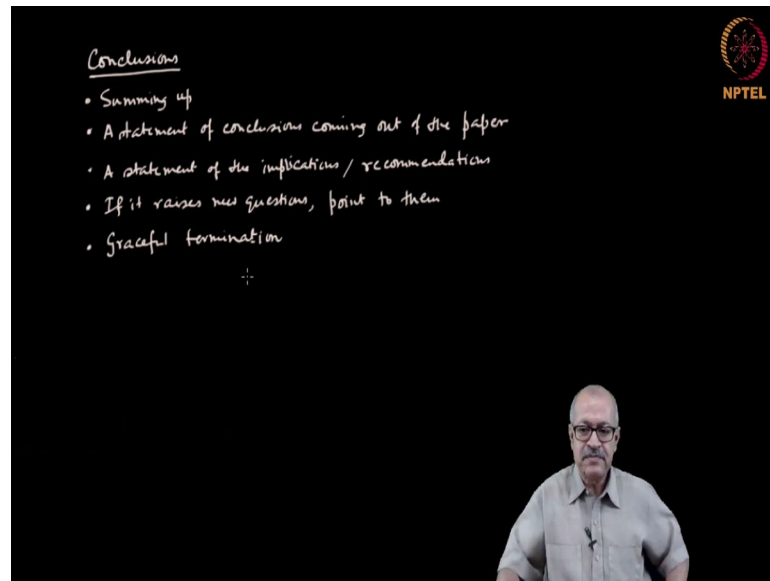
Finally, the paper has to end with the Conclusion section. This is the penultimate section of the paper. So, the reader would expect to find the 'take home message' in the Conclusion section. The conclusion section has to contain the following, basically summing up. It should sum up the paper. A statement of the conclusions coming out of the paper. Every paper, or the conclusions out of it, have some implications. So, a statement of the implications and maybe recommendations. If the work done in the paper, the conclusion drawn from the paper, raises new questions, then point to them. And finally, there has to be some kind of a graceful termination. It should not sound like an abrupt ending. So, these are the contents of the Conclusions section.

Like the Introduction, the Conclusion section is probably the most read. Many people will not read the whole paper; will read the introduction, read the conclusion, and draw their own understanding out of that, and maybe shift through some images, some pictures, and that is it. So, you have to keep that in mind that many people do not read the paper completely. Therefore, you have to write the Conclusions in such a way so that the reader gets a take home message out of that.

You have to summarize the key results in a way using the appropriate phrases so that the take home message goes. You notice that the main conclusions out of the work are stated once in the Abstract, again in the Introduction, again in the Conclusion, and maybe in the intermediate sections where the conclusions are actually reached; there also you may

have said that. Never use the same language in all these places. It has to be stated every time in a different language, never copy and paste from one place to another.

This is a very bad mistake that students often do when they write papers for the first time, because the same kind of statements have to be made in different places. The Introduction has to point to what conclusions are being made in this paper, the Abstract has to do the same thing, and finally the conclusions are there in the Conclusion section. And these should not be in the same language. Appropriately frame the language, write them afresh, so that the reader does not get bored.