Introduction to Professional Scientific Communication
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Lecture - 13
Writing the Results Section

Welcome to week four lectures of this course Introduction to Professional Scientific Communication. So, in the previous week, we have looked into the concept behind you know how do you arrive at a title and how do you write abstract. So, this week we are going to look at the other elements of a scientific paper.

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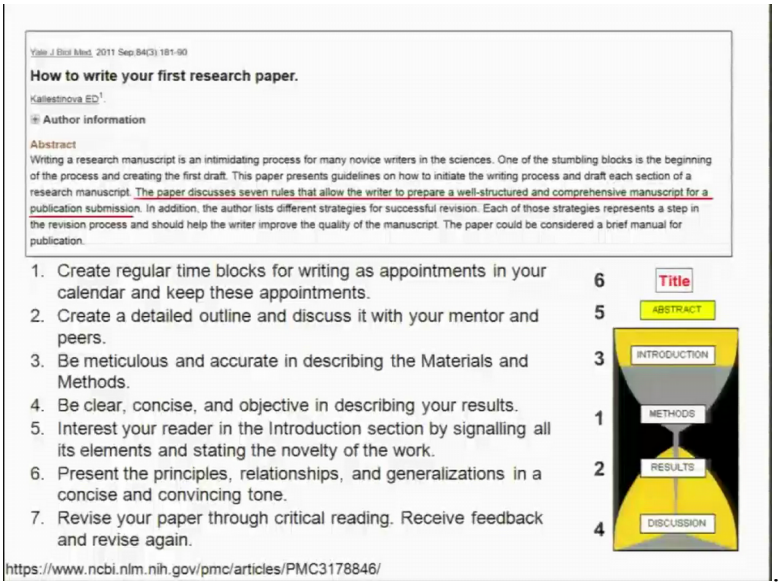

So, these are the seven commandments that you have been discussing throughout the course. And we have been discussing about the various elements that constitute an effective scientific research paper. And I already introduced this particular research paper to you which gives you the overall you know guidelines as to how do you put together your research ideas observations into a very good research paper. I am sure all of you have gone through this. If you have gone through, it going to really help. What I said was that we start with at least our you know a discussion on the scientific papers started with abstract as to how do you write abstract.

But what I also want to tell you is that when you write a research paper you do not start with the abstract, you basically start with the methods, because it is extremely difficult to start writing your abstract because the abstract is something that is a summary of the entire paper. So, you cannot summarize something that you are not yet completed therefore, you start with something that is much easier to begin with. So, the best possible section that you can begin with without much of preparation is the methods because you have carried out.

You can see that most often people start with the methods and then they go and write results and then they come to introduction, and then finally, they do what is called discussion. So, this is how normally the writing is done. So, what are you going to discuss today is about how do you write your result section in a research paper or your thesis. One take home message for how you should write method section is that be clear concise and objective in describing your results, so that is precisely the point because we are looked at the methods earlier. Now, we are going to talk about how do you write your results.

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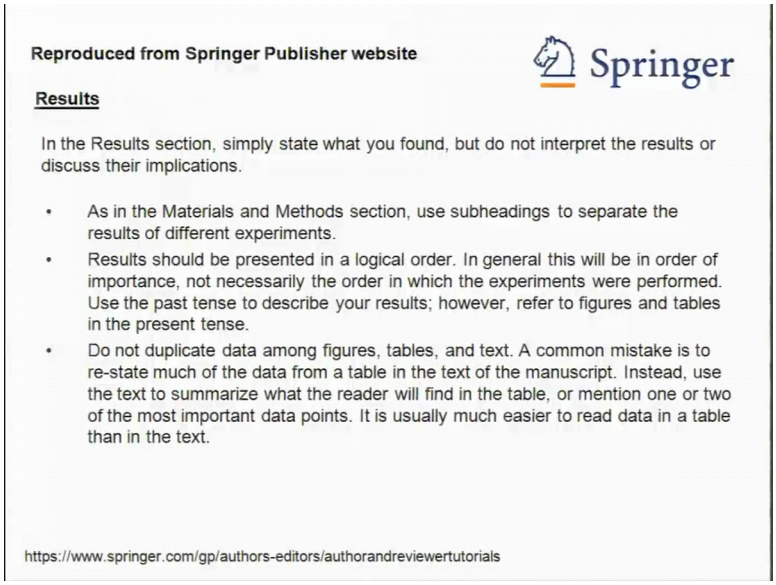

So, let us see some of those elements. So, what I am going to show you is again some of these guidelines that are from publishers for example, Springer is the one that link is given in the slide below which really tells you as to how you should write your results section. The result section simply state what you found without actually interpreting your

results specifically it is an observation. So, you should not interpret the results or discuss the implications of your results, you should narrate as to what you found. And why do you think is what you found is correct these all you have to say.

As in the materials matter section, use subheadings to separate results of different experience because not all of them gel well. So, you have to have different paragraphs you have to have different sub headings, therefore, before a reader looks into that particular section he sort of understand as to what is being discussed in that particular paragraph or particular section. Therefore, you should have a subheading which clearly tells what is the take home message of that particular section; so that is very, very important.

And results should be presented in a logical order. It is not necessary that you narrate the observations in the chronological order, it does not happen that way, because you may have started with certain experiment and the experiment would have let to some other question, therefore you are done something else, therefore it is not necessary that it is in the chronological order. More often, it is in the order of importance. So, depending on what objectives or what research question that you are asked, so you have these objectives stated. Most often the way the results are say you know sort of written is that you align them towards the object to therefore, each objective is taken and you sort of you know say as to this was my question, this is the way I approached it, and this is what I found.

So, in general this will be an order of important not necessarily in the order of which the experiment where performed right. So, use the past tense to describe your results. You would always say that we carried out this particular experiment and these are results that we found. So, it should be always in the past tense. And refer to figures and table in the present tense, because you know you always have some data that data cannot be presented everything in the text. So, you would have it as the form of a table or you would have in the form of a chart or you would have the form of a figure. Therefore, you should refer to. So, it should be, it should be stated like as shown in figure one. Now, you cannot write here as was shown in you know if you figure one right. So, it should be in the present tense.

So, do not duplicate data among figures that is one important you know guidelines that you cannot have for example, a table as well as a bar diagram as well as some other diagram which are again represents same data, it is a duplication of the data that is not. You have to choose as to which mode of you know presentation is best suited for the kind of data you have. So, the table would be good enough or it should be a bar diagram or should be a pie chart this is something that you go to upfront decide and present only the one that is best suited for the kind of a data that you have. We will discuss about that in a few minutes from now.

A common mistake is to restate much of the data from the table in the text of the manuscript. So, you have a table and the table has got in various parameters, various data that are obtained. Then if you start saying everything then again it is a duplication, because you have a table which helps the reader to better understand as compared to for example, narrating it in a textual form. So, you have the table to cut down your words because that explains better. Therefore, you do not want to restate everything that is there in a table, but you need to highlight as to what are the trend, what are the pattern what is the major take home massagers right.

So, use the text to summarize what the reader will find in the table or mention one or two of the most important data points which sort of summarizes the entire you know findings right. So, it is usually much easier to read data in the table than the text because any one in us to read. It is very difficult to for you to compare one column with other and so on with texts, but if it in the table form it is much much easier the reader can you know appreciate the difference and so on.

Include the results of statistical analysis in the text here to say that you have tested the significance of difference and so on. And then you will also state for example, what is the level of significance, what do you call it a p value, and what method you are used these are some other things that you would like to add in the text or you know either in the in the body of the manuscript. Or there are sections called a legend you know for a table or for a figure, you may have some description that again we will talk about little later.

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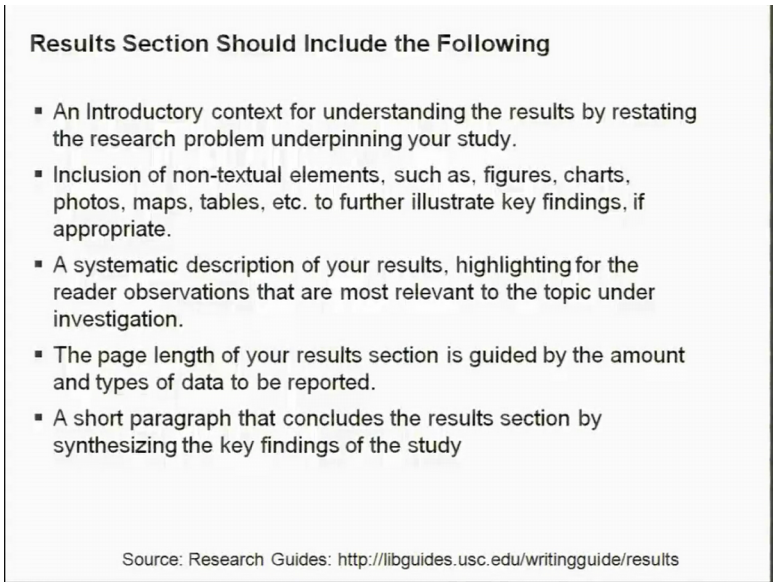

So, what should be the results section. So, there are some other guidelines again I am listing some of them result section should include the following. An introductory context for understand results by restating the research problem underpinning your study. So, before you say anything as to what you found, you should say as to what are the question, and how do you approached it, and therefore, you know what you know whatever observation you made you know that is what should come in that order. Therefore, as a reader I understand as to why you are doing this experiment, and why this results are important.

You know you are remember always that you are making a presentation or writing any report or thesis for the audience not for yourself right. Therefore, you have to state that therefore, I am realign to that particular question again. So, it is always good to have an introductory context for better understanding of the observation or appreciating the observation.

Inclusion of non-textual elements such as figures, charts, photos, maps, tables etcetera to further illustrate key findings if appropriate. For example, I looked at particular species of say butterfly and I have gone through different states of India and collected the samples or observed their pattern, and I am talking about how their wing pattern varies with for example, the climate or the latitude or whatever it is right. If that is my observation then I want to say I have collected butterfly from 20 different you know

places in the country. Now, instead of saying so on so village from so and so state. Now, if I have a map and I have identified all these villages as to where they are, and where I have collected these species, and then and I have drawn certain wing pattern in each of those you know dots that represent the location in the map. Then it gives to the reader a take home messages do well how many if you look into this from north to south, east to west this is how the distribution is. These are the place that I visited a collected sample that communicates better way as compared to for example, your writing everything in the result section.

So, you need to have different elements of your presentation for example, as I told you figure, charts, bar, diagram, maps and so on all these things should be ready before you start you know writing the results. So, in fact, even before you start writing results, you should have prepared all these figures, all these charts, all these schematics, all these map, you should have been complete in fact, it is part of the result section before you write you should have completed that.

So, what else you have in results section a systematic description of your results, highlighting for the reader observation that are most relevant to the topic under investigation. So, when you carry out any experiment you are going to gets some of the results the observations may after you know completing the you know the experiment you would feel, this particular result is not really helping me to explain whatever question that I asked right. It is to omit that; it is to you know not to mention that because that is not really helping the main story of your paper. So, therefore, it is ok, but you should also remember that it is not that you should in you know exclude any result that does not fit into your hypothesis which say that the hypothesis is incorrect that is not ethically right.

So, you should have enough you know decision kind of arrive at a decision as to whether the particular result should be added to the manuscript or not depending on whether that helps you to convey or that whether that you know sort of answers any of the objectives that you have stated. If it is not relevant to that then it is to omit, but not the one that is not falling into your hypothesis you know that is not correct. So, the systematic description of a results highlighting the observation that are more relevant to the topic under investigation.

The page length of result section is guided by the amount and types of data you reported. So, often you would have if you are writing a scientific manuscript, often you would have this particular challenge because they would say that you can have only for example eight figures or three tables or twelve a page of you know all the data and so on. Therefore, when you write any manuscript, you know you need to first concert that which journal you are planning to do submit, and which section of that particular journal you are planning to submit your manuscript and according you to prepare.

Often what happens you may have data that are not forming the core element of your observation, but these are supportive data you are done in many different types of you know experiments to arrive at the same point all are supporting your point, but that need not come and you know as part of the main paper. So, what often people do is at you know collate them into what is called as supplementary material, these are you know additional data that are presented, but not necessarily going into the main paper, but they are kept for those readers who are interested in you know looking into more details. So, these are different ways of doing it, but in thesis there is nothing called supplemental everything is part of your thesis to you narrate the exactly the same way otherwise you would have done if everything is included in the research paper therefore, the page length is important because you need to know that first.

So, the short paragraph that concludes the result section by synthesizing the key finding of the study. So, you are you know you have a subheading you have one or two paragraphs which narrates the findings that sort of form or fall into that particulars subheading, there at the end of that section you have to sort of you know summarize as to what is the take home message for that particular section. Because as a reader now when I have done with that now I will confusion as to what does it mean. So, and I end it sort of it assures me as to that I have understood what you are trying to say. So, these are some of the important element that you need to look at. And you are going to you know revisit each one of them with certain example therefore, you can understand better.

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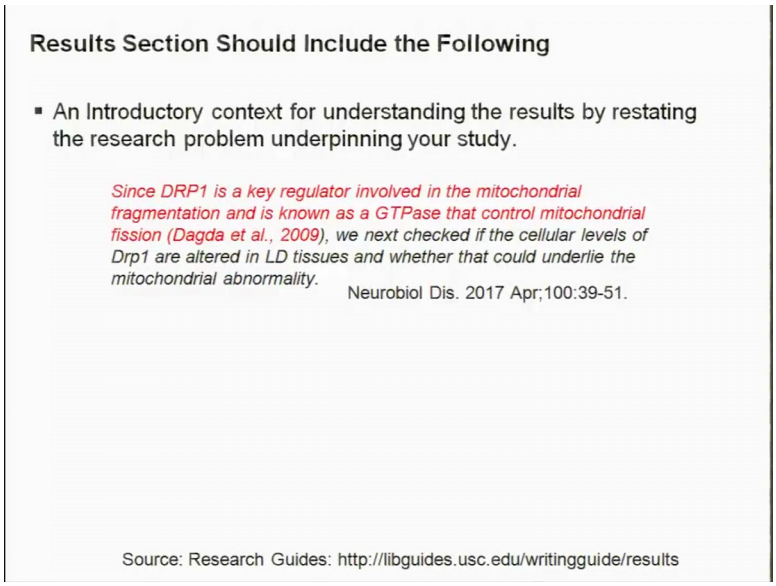

Let us say an introductory context for understanding the results by restating the research problem underpinning your study. So, you are going to say what you found, before you even say what you found, you have to tell what was your question, and how you addressed it, and how the findings are whether it is answering. So, I am just pulling out some of those intestines from some other research papers. So, here for example, you know the line that you know shown in the red font color is the one that introduces sort of aligns the results which with the introductory statement.

Since the DRP1 is a key regulator involved in the mitochondria fragmentation and is known as the GTPase that control mitochondrial fission, and these are the known facts that are references that could be previous you know reports and so on. So, you say that therefore, we wanted to test you know, we next check if the cellular levels of this particular protein is altered in whatever model that you are studying. So, it is sort of align the reader as to why or done that. Now, you are going to say what exactly you found you know in that particular experiment, then I am able to connect it with the earlier observations the expected results and you know how you how got, what is observation, what is interpreted and so on. So, it really helps the reader to appreciate the result.

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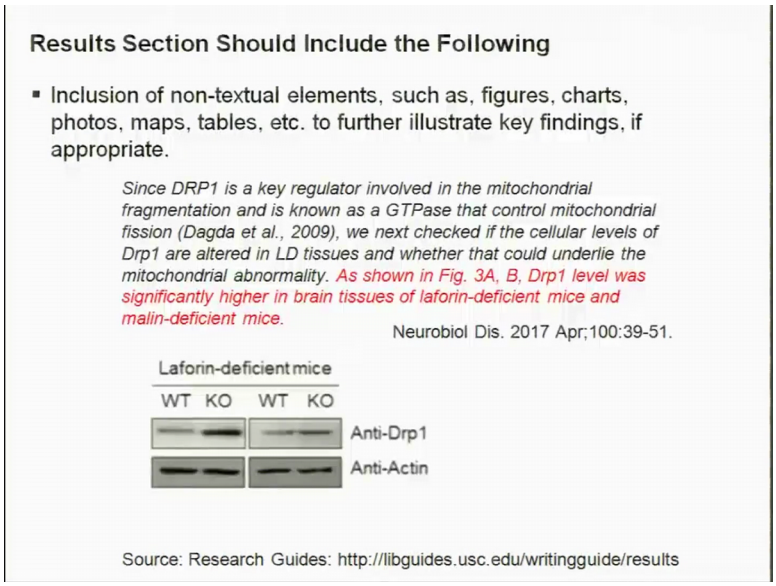

Let us look into the other section inclusion of non-textual elements such as figures charge photos maps tables etcetera to further illustrate key findings if appropriate. So, you have to have you know these things will made ready and then I will go you show you some of those such kind of you know examples. Now, it is I am stating the same thing that was shown before that since Drp1 that is the paragraph and it says we next step if the cellular levels of Drp1 are altered in the LD tissue whatever it is.

Now, we are introducing as to what is the result that you found, so that is what is shown in the red color font as shown in figure 3.A, B. Drp1 level was significantly higher in brain tissues of whatever model that you are study. It clearly tells you what happened. And you refer to the figure as a shown in figure because these are photographic images of you know the immunoblot what you call which sort of reflects as to the level of the protein that are present in here in case of brain from a mouse model that is you know model for a disease called a for a disease right.

So, now you can see that in the figure also the upper panel, you will find that whatever lane that is shown as KO which represent knockout for the gene that. Otherwise you know if is normally present than the individual normal if that gene is defective then you have end up having a disease that is the model for that particular disease in this particular animal model. Now, you see that the band intensity of the anti Drp1 whatever that panel

is much more intense as compared to the lane that represented by WT which is wild type normal animal, and then that is what narrated here.

So, you know you have a method section which clearly tells what how did you do this experiment now your result section you basically say as to what was the finding without really getting into the methods right. So, this is that is how you introduce the result. So, for this you have photograph image which you call now as a figure which has got a number, you refer to and highlight has to what is the findings. So, you do not really tell the other panel that is below the anti Drp1, you have another panel call anti actin which is basically you are loading control that you have had the same amount of protein in both sample, but the level difference that you find is only for Drp1 not for the total protein. So, basically you test with one of the so called housekeeping protein like actin, tubulin, and some other enzymes which are involved in normal function.

And you show that the band intensity of that particular protein does not change. So, that tells you that the protein amount is same, but you would not really narrate everything in the result section because these are all understood these are explained in the methods. And people who practice this kind of approaches know about it. So, you only highlight as to what is the significance of your observation that is what is shown here in the red color. So, this is one of the ways of doing.

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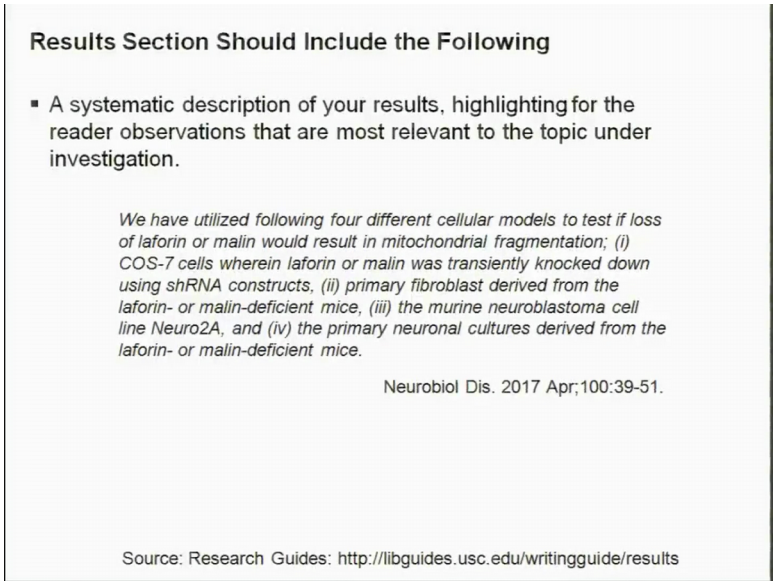

Now, then another point a systematic description of your results highlighting for the reader observation that are most relevant to the topic under investigation, it is a very interesting statement here highlighting for the reader you are understand. You are writing manuscript or you are presenting your work, it is always for the reader not for you; it is not that whether you like this or not it. It is for the reader to be convince that what you are saying is accurate, what you are saying makes sense, what you are saying a significant therefore, you have to present the data in such a way that reader can appreciate.

So, you know you had have a systematic description. So, how do you do that. So, there are ways of doing it, for example, you would have done various different types of approaches you would have used. So, you have to summarize that, you cannot go on saying everything right. So, you know because there are many things that are you know included in the metal section right details are given, but why did you use that and you know all those descriptions also come in different as either different section. So, one of the ways by which you can sort of give a systematic description one example I am showing here which I am more to read out for (Refer Time: 19:03) that we have utilized following four different cellular model to test if loss of law laforin or malin would result in mitochondrial fragmentation.

So, what happened after that you know each one of them approach in a model models are listed for example, the cell lines that I used, and then primary fibroblast derived from these animals and then mouse models and then primary neuronal culture. So, you are saying as to you know what is the way you have approach the problem, what are your thing and then what would be the outcome that would come little later. So, you how to give that kind of introductory statement to say that you know that how you are gone about doing as well before you exactly say what you are done.

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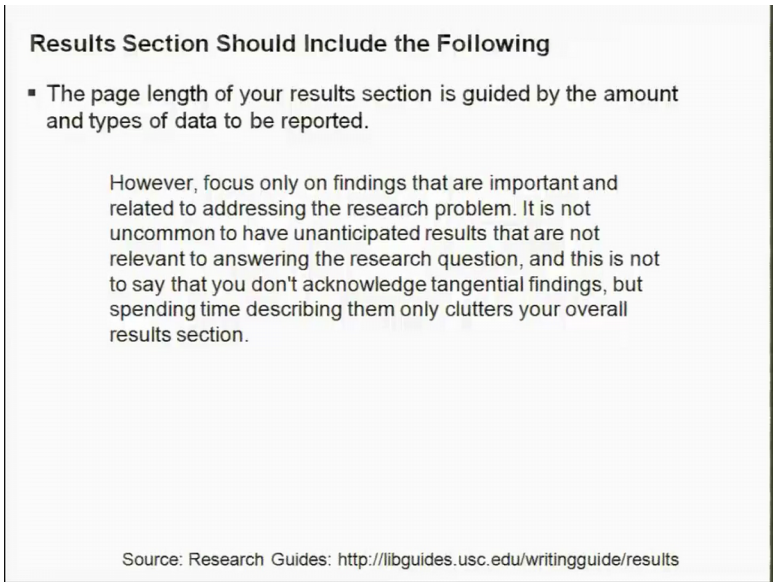

So, the page length of your result section is guided by the amount and types of data are you present right, it is very very important. Therefore, you know when you have you would have done you know large number experiments right that if then you need to know which are the experiment that are important which are the observation that are important for your paper the conclusion that you make and so on. This again, taking it from one of the websites the link that is given below. So, focus only on finding that are important and related to addressing the research problem. So, when you know start the discussion for any research project, you talk about hypothesis, you talk about your objectives, and then you have what is called as approach, how are you going to address those objectives.

Now, whatever experiment you done, some of them may not the outcome may not be a relevant to the objectives that you have therefore, you know you have to restrict yourself the one that are important related to addressing the research problem. So, you keep them. It is not uncommon to have unanticipated results that are not relevant to answering the research question, therefore, such observation you should exclude from this particular is research paper that may lead to some other hypothesis that may lead to some other you know theory or research question that is good that is how the research progress.

But it does not mean in your say keeping some results away because they do not fall into the main theme of the paper, it is not to say that you should not acknowledge findings

you know that sort of you know does not fall into your hypothesis that is not good. If something which is not you know supporting yours you have to narrate it right. But spending time more on something that are very very peripheral to your major questions, you know then what happens then you end up losing this space in the manuscript which otherwise you could have used for highlighting the important observation that you had and that would have really helped the manuscript. So, therefore, you need to know which one to be highlighted right.

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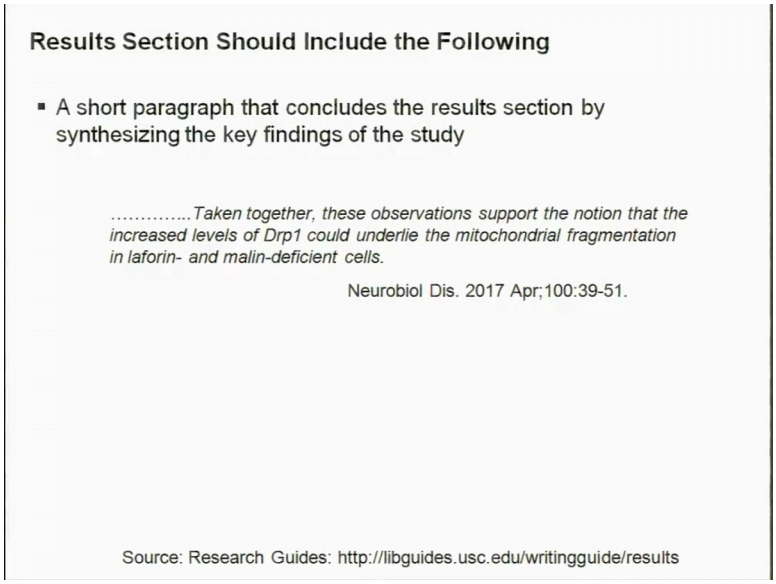

A short paragraph that concludes the result section by synthesizing this key findings of the study. So, it is extremely important because you know you would have narrated the results of various you know different approaches it may be running into one page a half page, then you have to have one or two sentences that would include that particular section as to what is it take home message right. For example, you know again I am narrating just copying one something from a paper which says taken together all the different approaches you are used all the result that are discussed about this particular sentence these observations support the notion that the increased levels of Drp1 could underlie the mitochondria fragmentation in whatever models that you are use. So, that clearly sort of narrates the final conclusion based on you know the observations that you had. So, it is a conclusion, it is not an interpretation you have to understand that right. Snap short of all that you have this, this we have looked at that your result section should how an introductory context, explaining as to why you are done and how the

observations are significant. And then you end up the result section with a take home message which sort of you know summarizes the outcome, so that is very important.

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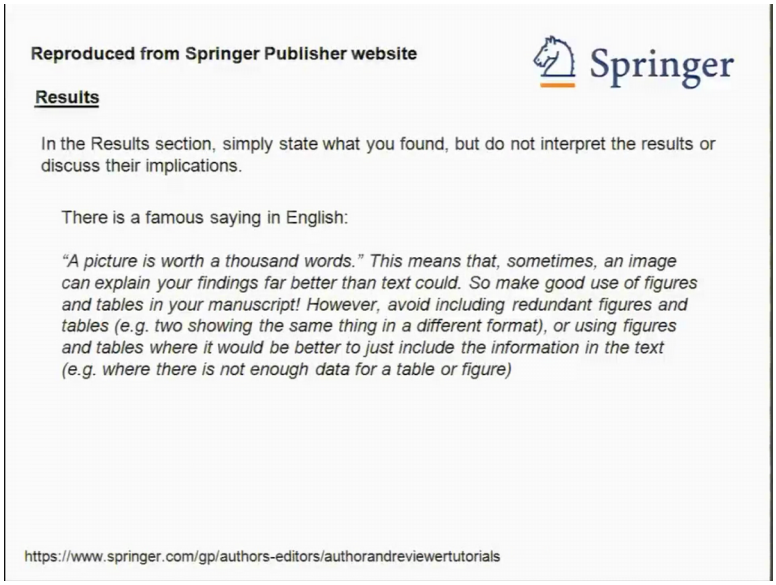

Some if the other guidelines are that the result section should simply state what you found, but do not interpret the results or discuss that implication. It is important because you are stating what you observed. Now, you should not start defending your results are should not you know sort of discussing your results because there is another section called discussion that is where you need to really discuss the implications of your findings right. There is a famous saying in the in English, a picture is worth a thousand words. It means that sometimes an image can explain your findings far better than text code. So, make good use of figures and tables in your manuscript. However, avoid including redundant figures and tables, showing the same thing in a different format using figures and tables where it would be better just to include the formation information in the text. So, this is you know this kind of you know important tips that that tells you.

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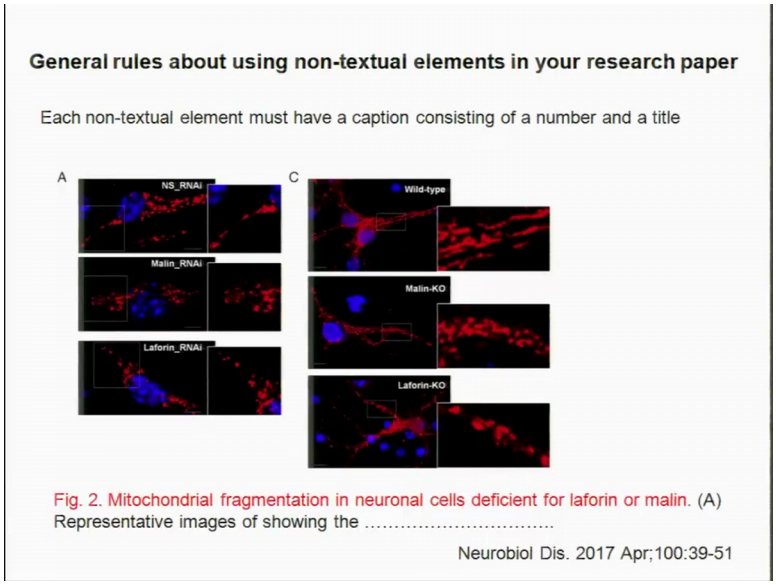

So, each you know when you when you talk about results that you are going to give you figures you are going to give tables, there are different formats. So, we are going to look into some of these elements as to how do you introduce that in the text and how do you make this and so on that will come. So, let us look into some of the general rules about using non textual elements in your research paper that are you know not written in text format right. So, each non textual element must have a caption consisting of a number and a title because then they are you know sequentially presented in that paper like figure one, figure two, figure three, it goes on each figures may have you know you knows subsection called figure 1, a 2, b 1, c and so on.

Now and say grouping of figure for example, figure 1 should have a caption as a title as to what the results mean a take home message again right. Likewise, you may have a table the table should have number table 1, table 2, table 3 and so on and then you may have a title for the table, so that is what you call us you know a caption. So, what is shown here is an example of the figure? So, here it is figure 2; and figure 2 as a you know a title legend you can see here, mitochondrial fragmentation in neuronal cells deficient for laforin or malin. So, clearly it tells what is that being sort of brought out, what is the message that is being conveyed in the figure right. And then you have figure 2 and then you have in within figure two 2 have figure a that is identified at the top corner left side a, b, c and so on. And the figures are also have certain labels which tells

you what you know there although they look very similar what experimental set they represent.

For example, in figure a, you have NS RNAI that represent one particular experimental set; then you have second one malin RNAI this is different experimental set. So, you have to label everything then only the reader will be able to understand which one refers to what right. So, and then you know what do you mean by NS RNAI what do you mean by malin RNAI this should be narrated in a section call legends something that we will talk about.

When you when you group these images right you what you say is that you basically present some what is called as the representative images. So, you have a large number of images that are taken when you experiment and use this images to analyze certain features. For example, here the red darts are nothing but something stained for mitochondria one other cell organelles in the sale of this particular model. And what the paper says is that the mitochondrial size you know is much smaller in certain condition that is why they call it a fragmentation. So, you know you quantify that you analyzed that. And then you present what is called as a representative image which represent you know a kind of a generalized feature about a mitochondrion given experimental setup.

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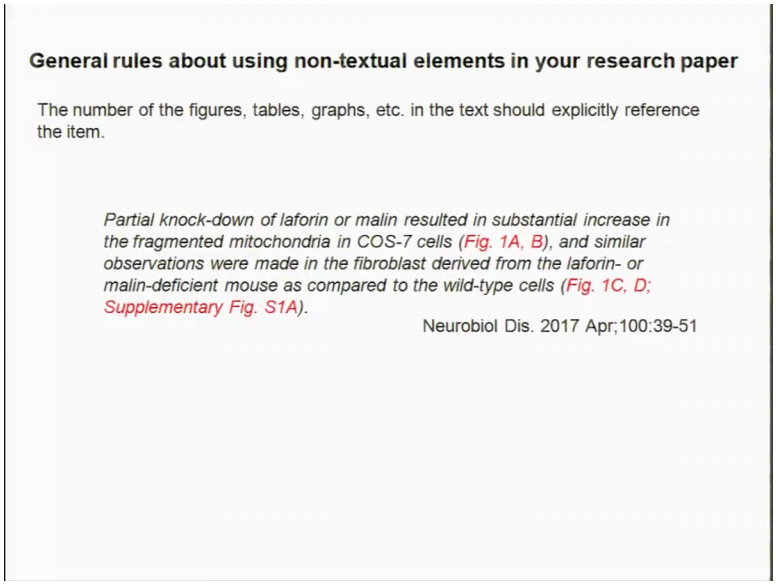

So, that should be there the number of the figures tables graphs etcetera and the text should be explicitly reference link them in the text. You should say that whenever you

narrate certain things observations and you are presenting an image or table to convey what you found and therefore, you should refer to that table refer to that figure by clearly stating that it is figure one table 1 or figure 1 A and so on, so that is an example here. For example, you know partial knockdown of laforin or malin results in substantial increase in the fragmented mitochondrion COS-7 cells now we can see the red font figure 1 A, 1 B right and so on then you have another one called supplementary figure these are additional data that is given. So, that is how you sort of link you will each in the every data you know a take home message of the group of the figure that you are represented should be narrator in the text and then should be referred to in the text result section as well.

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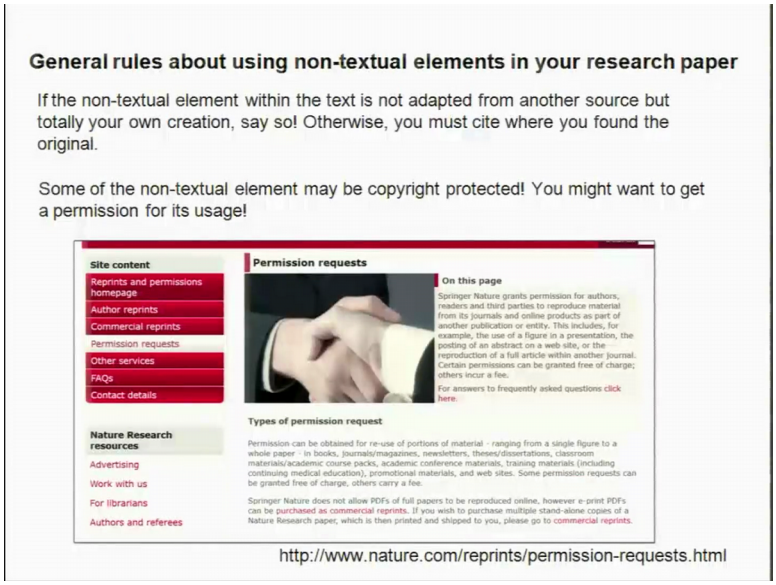

If the non-textual element within the text is not adapted from, if not adapted from another source, but totally your own creation say so, so for example, you made some schematics right and that is yours right. So, therefore, you know you say that based on our results, we propose the schematic you know pathway and things like that which is a pathway which is presented in the schematic diagram figure 3, so that is yours because you are stating them. But if you are borrowing it from somebody and you are silent about it, then it is not ethical. So, you have to give the original source right you have to cite that, we will revisit some of these ethics little later.

Some of the non-textual elements maybe copyright that is exactly are saying that you cannot use anything that is present anywhere. For example, somebody has published a paper and you are you know taking some image from there and putting in your research paper, you need to understand that every journal has got what is called as a copyright. So, you cannot again use that for printing another research article right. So, then you should have you know obtained their permission is important to reproduce right.

So, normally the journal research papers or figures are given you can freely use it for teaching purpose. For example, I am teaching here the course and I am using many of these figures that are there in the research article, but what I have done always I cited this is from this particular paper so that is important. So, you cite it because this is teaching purpose it is normally allowed you know it if you go and read about the journal policy copyright policy they will clearly say that for classroom teaching, for presentation, scientific discussion this is allowed, you can use it, but you cannot reproduce meaning you cannot print them again.

So, when you publish again in a paper it is going to be printed again, again that belongs to another publisher. So, you cannot use this without the consent you know there is a copyright violation. So, you have to go and get the permission you know that is very very important. So, you have to read. So, you know that is something that I have doing here this particular link and the snapshot of a page says that you need to get permission if you really want to reprint a given figure in your paper or whatever right. So, it is very important. So, therefore, you know you want to go and read about this because you do not want to violate because then if you do then you are against the law, so that is not something that is allowed. So, you may be you know taken to the court for a liability and so on.