“Essentiality of well-applied scientific presentation principles and correct use of presentation software”

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Abstract

A scientist spends a significant amount of time attending conferences and presenting scientific work in front of a mixed audience -- those familiar and unfamiliar with the field of study. Scientific presentations are meant to produce interaction between scientists leading to collaborations, that result in scientific innovation. Hence, clearer scientific presentations lead to better opportunities for collaboration and innovation. This treatise highlights some principles found in published journal articles on effective science communication and correct use of presentation software. These principles have been drawn from experimental data on human cognitive capacity, attention span and perception studies. Scientific communication must be clear, simple and structured. In constructing a presentation, the presenter must pay high regard to how information is scaffolded one after another so that there is clear flow of thought. The presenter must also, as much as possible, convert scientific and technical terms into common language easily understood by the listeners. Adversely, improper use of presentation software such as PowerPoint™ often leads to poor thought retention among listeners.

The insights that are in this paper come more from scientific journal articles published under the topics of cognition, neuroscience, education, pedagogy (science of teaching), etc. What this discourse will hope to achieve is to create an ensuing dialogue about whether our practices and traditions in doing scientific presentations are in line with the theory and principles and conversely, if these theories that I will have presented are realistic and achievable.

Oral science communication is as valuable as a publication

The main medium of communicating scientific data is through publication in credible peer-reviewed journals. It is not valid science if it is not sourced from these journals. However, a scientist also spends a significant amount of the attending conferences and presenting his/her work in front of a mixed audience -- those familiar and unfamiliar with the field of study. Here are two suggested general purposes of presenting scientific data: (1) to contribute to and learn about the most recent advances in their field, and (2) to generate interaction that will be helpful for future directions of the research work or field[1]. What is critical in these presentations is the interaction that is generated by the presentation, more than the presentation itself.

[1] Why It's Important For You To Present Your Data at Scientific Conferences. http://www.apa.org/science/about/psa/2007/11/student-council-1.aspx. Accessed March 31, 2016

Good scientific presentations are the seeds of scientific innovation

If observations and scientific data were likened to puzzle pieces, the whole generality of scientific research may be likened to correctly fitting puzzle pieces together to form a larger piece. The role of a peer-reviewed journal (in the light of this analogy) is to assess whether the scientist's puzzle arrangement is sound or not. Henceforth, the scientific presentation is an effort to describe this puzzle arrangement that has been put together. It is an effort to systematically describe the results and implications of the study: the contours and edges of the puzzle piece. *This is done in hope that someone in the audience might have another piece that fits perfectly with the one being presented / described*. Scientific presentations are meant to produce interaction between scientists. This interaction leads to collaborations. And these collaborations (inter- or intra-field) produce scientific innovation! Oftentimes, the solution to the problems of a certain field of study are held by proponents working in other fields. Therefore, a presenter must clearly describe his or her work so that it can easily be grasped, especially by people who are not of the same discipline.

A scientist must excel in communication skills

An web-based article of the journal *Nature* has noted that "Science communication is rapidly becoming a core requirement for scientists"[2]. Moreover, Fischhoff, et al. 2011, notes that "the value of the scientist's work depends on how well they *communicate* their best conclusions and the strength of the evidence supporting it[3]. The importance of effective communication among researchers is highlighted by some studies such as this one by Fischer and Zigmond (1998), referencing from a 1995 article published in the Proceedings of the National Academy of Sciences. They write:

> "Researchers must be able to communicate effectively with colleagues, professionals in other fields, policymakers, and the lay public. *Leaders from industry cite the importance of researchers being able communicate their results and interact effectively with nontechnical professionals."* (emphasis, mine)[4]

In a book chapter entitled "Communicating Science", Michael Weigold writes: *"*The scientist wishing to communicate directly with a public about issues of science faces several important hurdles. Perhaps the most basic of these is language...Hence the scientist must be skilled at translating ideas from the technical language of his or her discipline into a [language]

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[2] Seed C. Science communication: sculpting your role. 2015. http://blogs.nature.com/naturejobs/2015/10/26/science-communication-sculpting-your-role/. Accessed March 31, 2016

[3] Fischhoff, Baruch, and John Kadvany. 2011. *Risk: A Very Short Introduction*. OUP Oxford. As cited in Four steps for effective science communication. http://www.scidev.net/global/communication/opinion/four-steps-effective-science-communication.html. Accessed March 30, 2016

[4] Fischer, Beth A., and Michael J. Zigmond. "Survival skills for graduate school and beyond." *New Directions for Higher Education* 1998, no. 101 (1998): 29-40.

currently accessible to lay audiences".[5] These principles are important to keep in mind throughout the preparation of a scientific presentation.

Preparing to present

In preparing to present, it is crucial for a speaker to estimate the amount of knowledge the general audience has regarding the field of study that is to be presented. He/she should anticipate the depth of understanding his would-be audience has regarding the field of study to be given. In reality, the audience will be looking for relevance. Therefore, too much detail or explanation of a certain method or result may distract the audience and be counter-productive to the relevance of the data. Presentation structure ensures these principles are implemented.

Presentation structure

Presentation structure is very important. What is being communicated are not random just pieces of data but pieces of data strung together to support a complete scientific thought. We must have a structure in place to ensure completeness of thought; a structure that ensures that the previous statement builds up to the next, and so on and so forth. Michael Alley, in his book, "The Craft of Scientific Presentations…", writes "The success of a presentation hinges on its structure"[6].

Usually, when speakers are informed that they are to present their work in a conference, they jump into making the powerpoint presentation. But this probably the most obvious blunder a presenter can make. The powerpoint presentation is meant to be a visual aid (more of this discussed later). The presenter must start with an outline, written on a piece of paper or typed out on a word processor (e.g. Microsoft Word™). This outline will ensure this in a presentation structure. At the least, an outline will ensure the following elements of structure:

1. It ensures that all relevant areas of the study will be covered in the presentation with appropriate depth of treatment. Some audiences require more explaining than others. Some audiences require more introduction than others. Therefore, preparing an outline helps determine how much time is going to be spent clarifying a certain section of your presentation. In the end, it can assure the speaker that the information is properly delivered within the bounds of the time limit given.

2. It ensures that the presentation should start and end with the *big picture.* This is important because it is the big picture that makes it relevant to the audience. The

[5] Weigold M. 2002. Communicating Science. http://www.au.af.mil/au/awc/awcgate/doe/benchmark/ch17.pdf. Accessed March 31,2016

[6] Alley, Michael. 1996. *The craft of scientific presentations*. Springer, p.53

speaker must first clearly describe the big picture. Then shall he present the problem, objectives, methods and results in a way that does not lose sight of the big picture. Lastly, he then again goes back to the big picture as he gives his conclusions and recommendations. The better the big picture can maintained throughout the presentation, the more relevant the presentation will be.

3. It ensures that there is consistent flow-of-thought throughout the presentation. This highlights the importance of transition statements or pauses. Transition statements are what are said when the speaker shifts from one section to another (i.e. results to conclusions). Transition pauses prompt the audience that the presenter is done tackling the current section and is proceeding to the next. Transition statements and pauses help the audience stay on track. It is documented that Dr. Linus Pauling was continually skipping the lectures of the physicist Robert Millikan due to the *lack of organization* in the latter's lectures[7].

The advantage of starting with an outline is that the speaker can view the presentation as a whole. Moreover, it will be easier to make adjustments later when the same presentation s given again to a different audience. After the outline has been drafted, the slide presentation can now be built properly.

Correct use of presentation software

The slide presentation is meant to be a visual aid. Which means that its purpose is to simply highlight what is being said as reflected on the outline. Unfortunately, many use the powerpoint presentation as speakers' notes. The powerpoint tends to be filled with sentences and the speaker simply reads through each slide until the end of his or her presentation. Studies have shown that using powerpoint as speaker's notes diminishes audience engagement and learning.[8]

In a study conducted in 2012, researchers experimented on 209 university students with regards on how well they can retain information from speakers using presentation slides as speaker's notes. Group A would listen to a speaker talking about a lot of information without a powerpoint slide. Group B had to listen to the same speaker, with the same amount of information but at the same time reading what he says exactly on a powerpoint slide. The results indicate that Group A (listened with no presentation) retained the most information compared to group B (listened with verbatim presentation). The researchers explained that the

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[7] Anthony Serafini, Linus Pauling (New York: Paragon House, 1989), p. 33 as cited in Alley, Michael. 1996. *The craft of scientific presentations*. Springer, p.53

[8] James, Karen E., Lisa A. Burke, and Holly M. Hutchins. 2006. "Powerful or Pointless? Faculty Versus Student Perceptions of PowerPoint Use in Business Education." Business Communication Quarterly 69 (4): 374–96. doi:10.1177/1080569906294634. as cited in It's not PowerPoint's fault, you're just using it wrong. https://theconversation.com/its-not-powerpoints-fault-youre-just-using-it-wrong-43783. Accessed March 31, 2016

reason the students in group B were not able to retain much information was because they experienced “dysfunctional allocation of attention”. In other words, they had inappropriately divided attention between listening and reading, hence diminishing information retention.

Here are some other highlights of their research:

- The more words there are on the slide, the less information the audience can retain
- Use of presentation slides negatively affects retention of oral information.
- Use of *concise slides* avoids this effect and yields highest overall retention.[9]

One application from the results of the aforementioned study is to use blank slides when giving an oral explanation of a very important matter. Since there is nothing to understand in a blank slide, the attention of the audience is directed to the speaker and the information being delivered orally. The use of blank slides within a presentation may help audience focus on what is being said, thus preventing *dysfunctional allocation of attention*.

Careful consideration must also be given to the level of detail in each slide and how the details is systematically presented. Understanding the dynamics of attention and cognition may prove helpful on this matter. For instance when a slide with significant detail is flashed before an audience, the audience members automatically tries to make sense out of it. This making sense of perception is an involuntary response[10]. Thus, if more detailed slides are passed on too quickly, the audience lose track of their train-of-thought. Therefore, the more detail the slide has, the more it is necessary that the speaker spend more time on it. Take for example a title slide with a long title such as “Optimization of nitrogen and carbon requirements and culture incubation time for maximum poly-β-hydroxybutyrate production by *Bacillus sp*. JL47 isolate from shrimp pond sediments”[11]. If the long title in the slide is simply read, and after which the next slide is brought up, the audience thinking would have been disconnected as the slides shift too soon. This is because that the mind has already begun to understand the slide as it was flashed. The human mind has the natural tendency to organize itself and make sense of whatever information presented before it[12]. Therefore, in the case of busy slides (i.e. information-abundant slides) the speaker must spend longer time on the slide and say helpful words that describe the information on the slide. This helps the audience stay on track with the information their mind had already begun to process.

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[9] Wecker, Christof. 2012. “Slide Presentations as Speech Suppressors: When and Why Learners Miss Oral Information.” Computers & Education 59 (2): 260–73. doi:10.1016/j.compedu.2012.01.013.

[10] Piaget, J., & Inhelder, B. 1947. Diagnosis of mental operations and theory of the intelligence. American Journal of mental deficiency, 51(3), 401.

[11] Bautista NB, Janagap SP, Laranja JLQ, Azucena-Topor V, Martizano JO. 2016. Optimization of nitrogen and carbon requirements and culture incubation time for maximum poly-β-hydroxybutyrate production by *Bacillus sp*. JL47 isolate from shrimp pond sediments. Manuscript in preparation.

[12] Piaget, J., & Inhelder, B. 1947. Diagnosis of mental operations and theory of the intelligence. American Journal of mental deficiency, 51(3), 401.

Another scenario is when the speaker shows a complex or figure such as compounded graphs and multivariate surface plots. Brushing over the complex slide may prove unhelpful to the thought process of the audience. Since the minds of the audience had already started to make sense of the graph as soon as it was flashed, it will be most beneficial to give a long pause as the slide is flashed before explaining the slide -- to let the complex visual information *sink in*. PowerPoint™ (and other presentation software) are tools built for a very specific purpose: to display visual aids meant to complement verbally delivered content[13,14]. This means that it must contain, mainly (but not limited to) *pictures / figures relevant to what is being said*.

A good presenter is a structured presenter

Scientists and researchers who are poor at science communication is likely due to lack of opportunity for practice, among anything else.[15] Even attempting to explain your work to a lay person is good practice in itself. The sentiments of two of the great theoretical physicists of our time, Albert Einstein and Richard Feynman (the atomic bomb), about scientific communication is right captured by Kurt Vonnegut. Vonnegut writes, “any scientist who couldn’t explain to an eight-year-old what he was doing was a charlatan [quack].”[16] How is it possible to explain scientific data to an 8-year-old? The answer is structure. Jean Mandler (1983) writes: ”The meaning of a particular treatise does not exist until some structure, or organization, is achieved [17]. Take the stories and movies we love. We take delight in them simply because they are neatly structured: the characters are well-developed; the plot is well-defined[18]. The same will likely be true scientific presentations. The audience get drawn into the presentation, not mainly because the speaker is lively, nor because the powerpoint is beautiful, but because they are rightly

[13] It’s not PowerPoint’s fault, you’re just using it wrong. https://theconversation.com/its-not-powerpoints-fault-youre-just-using-it-wrong-43783. Accessed March 31, 2016

[14] You may also be interested in reading this published article regarding the proper function of powerpoint: Horvath, Jared Cooney. 2014. “The Neuroscience of PowerPointTM.” Mind, Brain, and Education 8 (3): 137–43. doi:10.1111/mbe.12052.

[15] Michael Weigold writes: With some exceptions, most working scientists have little responsibility for dealing directly with the public. An elite group of scientists, however, especially those who publish in journals monitored by the press, are often sought for interviews by media reporters. Among the journals regularly scanned by science journalists are Science (the weekly journal of the AAAS), Nature, the New England Journal of Medicine, and the Journal of the American Medical Association. These journals frequently “speak not only of the technical matters of science but also of policy, politics, and conscience” (Burkett 1986, 8). Some famous scientists also are given relatively direct access to the public by news organizations. These “visible scientists” include Nobel Prize winners, heads of prestigious institutions, and administrators of science-oriented agencies and labs (Goodell 1977). There is a widespread perception that scientists are not effective communicators, at least when the audience is the general public. Dr. Neal Lane (cited in Hartz and Chappell 1997), former head of the National Science Foundation, claimed: With the exception of a few people . . . we don’t know how to communicate with the public. We don’t understand our audience well enough—we have not taken the time to put ourselves in the shoes of a neighbor, the brother-in-law, the person who handles our investments—to understand why it’s difficult for them to hear us speak. We don’t know the language and we haven’t practiced it enough. (P. 38). Weigold M. Communicating Science. http://www.au.af.mil/au/awc/awcgate/doe/benchmark/ch17.pdf. Accessed March 31,2016

[16] How to Give a Great Scientific Presentation. http://mesa.ac.nz/2011/02/presentations/. Accessed March 31 ,2016

[17] Mandler, Jean M. 1983. "Stories: The Function of Structure."

[18] Ibid.

structured. And it is apt and proper structure that makes the presentation of scientific developments exciting.

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Recommended readings

Alley, Michael. 1996. The craft of scientific presentations. Springer

Wecker, Christof. 2012. “Slide Presentations as Speech Suppressors: When and Why Learners Miss Oral Information.” Computers & Education 59 (2): 260–73. doi:10.1016/j.compedu.2012.01.013.