How to Summarize an Article

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Agenda

1. Summary purpose
2. Structured analysis
3. Written Summary

1. Summary Purpose

Purpose of Summary Exercises

Analysing and summarizing are crucial skills (for any job)

- Analysis
  - Reading: Absorb the text
  - Extracting: Extract information
  - Synthesizing: Gain understanding
- Summary
  - Summarizing: Explain to others

2. Structured Analysis

Structured Analysis Process

Step 1: Extract notes

- Read and markup text
- Annotate (“code”) marked text

Step 2: Synthesize insights

- Synthesize concepts
- Sift and sort into categories

Will reappear as qualitative data analysis

Step 1.a: Markup Text

boys, after disciplining them in one way or another, feels guilty for the rest of her life because she didn't do "the right thing," according to the experts.

So we really ought to look into theories that don't work, and science that isn't science.

I tried to find a principle for discovering more of these kinds of things, and came up with the following system. Any time you find yourself in a conversation at a cocktail party in which you do not feel uncomfortable that the hostess might come around and say, "Why are you fellows talking shop?" or that your wife will come around and say, "Why are you flirting again?"—then you can be sure you are talking about something about which nobody knows anything.

Using this method, I discovered a few more topics that I had forgotten—among them the efficacy of various forms of psychotherapy. So I began to investigate through the library, and so on, and I have so much to tell you that I can't do it at all. I will have to limit myself to just a few little things. I'll concentrate on the things more people believe in. Maybe I will give a series of speeches next year on all these subjects. It will take a long time.

I think the educational and psychological studies I mentioned are examples of what I would like to call Cargo Cult Science. In the South Seas there is a Cargo Cult of people. During the war they saw airplanes land with lots of good materials, and they want the same thing to happen now. So they've arranged to make things like runways, to put fires along the sides of the runways, to make a wooden hut for a man to sit in, with two wooden pieces on his head like headphones and bars of bamboo sticking out like antennas —he's the controller—and they wait for the airplanes to land. They're doing everything right. The form is perfect. It looks exactly the way it looked before. But it doesn't work. No airplanes land. So I call these things Cargo Cult Science, because they follow all the apparent precepts and forms of scientific investigation, but they're missing something essential, because the planes don't land.

Now it behooves me, of course, to tell you what they're missing. But it would be just about as difficult to explain to the South Sea Islanders how they have to arrange things so that they get some wealth in their system. It is not something simple like telling them how to improve the shapes of the earphones. But there is *one* feature I notice that is generally missing in Cargo Cult Science. That is the idea

that we all hope you have learned in studying science in school—we never explicitly say what this is, but just hope that you catch on by all the examples of scientific investigation. It is interesting, therefore, to bring it out now and speak of it explicitly. It's a kind of scientific integrity, a principle of scientific thought that corresponds to a kind of utter honesty—a kind of leaning over backwards.

For example, if you're doing an experiment, you should report everything that you think might make it invalid—not only what you think is right about it: other causes that could possibly explain your results; and things you thought of that you've eliminated by some other experiment, and how they worked—to make sure the other fellow can tell they have been eliminated.

Details that could throw doubt on your interpretation must be given, if you know them. You must do the best you can —if you know anything at all wrong, or possibly wrong—to explain it. If you make a theory, for example, and advertise it, or put it out, then you must also put down all the facts that disagree with it, as well as those that agree with it. There is also a more subtle problem. When you have put a lot of ideas together to make an elaborate theory, you want to make sure, when explaining what it fits, that those things it fits are not just the things that gave you the idea for the theory; but that the finished theory makes something else come out right, in addition.

In summary, the idea is to try to give *all* of the information to help others to judge the value of your contribution; not just the information that leads to judgment in one particular direction or another.

The easiest way to explain this idea is to contrast it, for example, with advertising. Last night I heard that Wesson Oil doesn't soak through food. Well, that's true. It's not dishonest; but the thing I'm talking about is not just a matter of not being dishonest, it's a matter of scientific integrity, which is another level. The fact that should be added to that advertising statement is that *no* oils soak through food, if operated at a certain temperature. If operated at another temperature, they *all* will—including Wesson Oil. So it's the implication which has been conveyed, not the fact, which is true, and the difference is what we have to deal with.

We've learned from experience that the truth will out. Other experimenters will repeat your experiment and find out whether you were wrong or right. Nature's phenomena will agree or they'll disagree with your theory. And,

although you may gain some temporary fame and excitement, you will not gain a good reputation as a scientist if you haven't tried to be very careful in this kind of work. And it's this type of integrity, this kind of care not to fool yourself, that is missing to a large extent in much of the research in Cargo Cult Science.

A great deal of their difficulty is, of course, the difficulty of the subject and the inapplicability of the scientific method to the subject. Nevertheless, it should be remarked that this is not the only difficulty. That's *why* the planes don't land—but they don't land.

We have learned a lot from experience about how to handle some of the ways we fool ourselves. One example: Millikan measured the charge on an electron by an experiment with falling oil drops and got an answer which we now know not to be quite right. It's a little bit off, because he had the incorrect value for the viscosity of air. It's interesting to look at the history of measurements of the charge of the electron, after Millikan. If you plot them as a function of time, you find that one is a little bigger than Millikan's, and the next one's a little bit bigger than that, and the next one's a little bit bigger than that, until finally they settle down to a number which is higher.

Why didn't they discover that the new number was higher right away? It's a thing that scientists are ashamed of—this history—because it's apparent that people did things like this: When they got a number that was too high above Millikan's, they thought something must be wrong—and they would look for and find a reason why something might be wrong. When they got a number closer to Millikan's value they didn't look so hard. And so they eliminated the numbers that were too far off, and did other things like that. We've learned those tricks nowadays, and now we don't have that kind of a disease.

But this long history of learning how to not fool ourselves —of having utter scientific integrity—is, I'm sorry to say, something that we haven't specifically included in any particular course that I know of. We just hope you've caught on by osmosis.

The first principle is that you must not fool yourself—and you are the easiest person to fool. So you have to be very careful about that. After you've not fooled yourself, it's easy not to fool other scientists. You just have to be honest in a conventional way after that.

I would like to add something that's not essential to the science, but something I kind of believe, which is that you should not fool the layman when you're talking as a scientist. I am not trying to tell you what to do about cheating on your wife, or fooling your girl friend, or something like that, when you're not trying to be a scientist, but just trying to be an ordinary human being. We'll leave those problems up to you and your rabbi. I'm talking about a specific, extra type of integrity that is not lying, but bending over backwards to show how you're maybe wrong, that you ought to do when acting as a scientist. And this is our responsibility as scientists, certainly to other scientists, and I think to laymen.

For example, I was a little surprised when I was talking to a friend who was going to go on the radio. He does work on cosmology and astronomy, and he wondered how he would explain what the applications of this work were. "Well," I said, "there aren't any." He said, "Yes, but then we won't get support for more research of this kind." *I* think that's kind of dishonest. If you're representing yourself as a scientist, then you should explain to the layman what you're doing—and if they don't want to support you under those circumstances, then that's their decision.

One example of the principle is this: If you've made up your mind to test a theory, or you want to explain some idea, you should always decide to publish it whichever way it comes out. If we only publish results of a certain kind, we can make the argument look good. We must publish *both* kinds of result. For example—let's take advertising again—suppose some particular cigarette has some particular property, like low nicotine. It's published widely by the company that this means it is good for you—they don't say, for instance, that the tars are a different proportion, or that something else is the matter with the cigarette. In other words, publication probability depends upon the answer. That should not be done.

I say that's also important in giving certain types of government advice. Supposing a senator asked you for advice about whether drilling a hole should be done in his state; and you decide it would be better in some other state. If you don't publish such a result, it seems to me you're not giving scientific advice. You're being used. If your answer happens to come out in the direction the government or the politicians like, they can use it as an argument in their favor; if it comes out the other way, they don't publish it at all. That's not giving scientific advice.

Other kinds of errors are more characteristic of poor science. When I was at Cornell, I often talked to the people in the psychology department. One of the students told me she wanted to do an experiment that went something like this—I don't remember it in detail, but it had been found by others that under certain circumstances, X, rats did something, A. She was curious as to whether, if she changed the circumstances to Y, they would still do A. So her proposal was to do the experiment under circumstances Y and see if they still did A.

I explained to her that it was necessary first to repeat in her laboratory the experiment of the other person—to do it under condition X to see if she could also get result A—and then change to Y and see if A changed. Then she would

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Step 1.b: Annotate Text

- Historically, out of crazy ideas, science
- Method of science: eliminate crazy ideas
- Crazy unscientific ideas are still alive
- Apparently, people like crazy ideas
- Why do people cling to crazy ideas?
- We believe in not-obviously crazy ideas as well, despite them not working
- Examples are today's methods of teaching, ways of treating criminals
- Sometimes good commonsense ideas are overruled by “science”
- The main measure of theory is: “does it work?”
- If a theory does not work, it is not science
- **Pseudoscience is nonsense that pretends to be science**
- There is a lot of pseudoscience in psychology and education
- The cargo cult is an example of a people going through the motions without understanding
- Cargo cult science is pseudoscience---assumed science without understanding
- Cargo cult science lacks integrity, a key ingredient of science
- Integrity in science means reporting everything about an experiment
- In particular if the information invalidates an experiment
- When describing a theory, provide all facts you know, for and against it
- **Hallmark of a theory is that it predicts something in addition to know facts**
- When doing science, empower others to properly judge your work
- Scientific integrity is more than just being honest; list all facts, cover all contexts
- Your reputation as a scientist depends on continued displayed integrity
- Scientists after Millikan were consciously or subconsciously anchored by his results
- Scientists manipulated results to conform with assumed truth

Step 2.a: Synthesize Concepts

- **Crazy ideas historically**
  - Historically, out of crazy ideas, science
  - The method of science: eliminate crazy ideas
- **Crazy ideas today**
  - Crazy unscientific ideas are still alive
  - Apparently, people like crazy ideas
  - Why do people cling to crazy ideas?
  - We believe in not-obviously crazy ideas as well, despite them not working
  - Examples are methods of teaching, decreasing crime by treating criminals
- **Pseudoscience as one form of today's crazy ideas**
  - Sometimes good commonsense ideas are overruled by „science“
  - **Pseudoscience is nonsense that pretends to be science**
  - There is a lot of pseudoscience in psychology and education
  - The cargo cult is an example of a people going through the motions without understanding
  - Cargo cult science is pseudoscience---assumed science without understanding
- **Main criteria that define good science**
  - The main measure of theory is: “does it work?”
  - If a theory does not work, it is not science
  - Cargo cult science lacks integrity, a key ingredient of science
  - When describing a theory, provide all facts you know, for and against it
  - **Hallmark of a theory is that it predicts something in addition to know facts**
  - When doing science, empower others to properly judge your work
  - Scientific integrity is more than just being honest; list all facts, cover all contexts
  - Your reputation as a scientist depends on continued displayed integrity

Step 2.b: Sort Into Categories

- **Crazy ideas**
  - Crazy ideas historically
    - Historically, out of crazy ideas, science
    - The method of science: eliminate crazy ideas
  - Crazy ideas today
    - Crazy unscientific ideas are still alive
    - Apparently, people like crazy ideas
    - Why do people cling to crazy ideas?
    - We believe in not-obviously crazy ideas as well, despite them not working
    - Examples are methods of teaching, decreasing crime by treating criminals
- **Pseudoscience**
  - Pseudoscience as one form of today's crazy ideas
    - Sometimes good commonsense ideas are overruled by „science“
    - Pseudoscience is nonsense that pretends to be science
    - There is a lot of pseudoscience in psychology and education
    - The cargo cult is an example of a people going through the motions without understanding
    - Cargo cult science is pseudoscience---assumed science without understanding
- **Good science**
  - Main criteria that define good science

3. Written Summary

Written Summary Process

Step 3: Outline summary

- Identify key insights
- Bring insights into proper order

Step 4: Write summary

- Decide on framing
- Expand insights into summary

Step 3.a: Identify Key Insights

1. **Crazy ideas** always existed; they gave birth to modern science and the scientific method as a counteraction
2. **Pseudoscience** is modern form of crazy ideas; differs from real science by lack of integrity, does not follow scientific method
3. **Proper science** uses proper methods, specifically experiments; experimenters need to be of full integrity; report everything; don't fool yourself, don't fool others.
4. **Science is a social endeavor;** will be difficult even in the future not to fool ourselves; expect failures to continue; keep striving

Step 3.b: Bring Insights Into Proper Order

1. Crazy ideas always existed; they gave birth to modern science and the scientific method as a counteraction
2. Proper science uses proper methods, specifically experiments; experimenters need to be of full integrity; report everything; don't fool yourself, don't fool others.
3. Pseudoscience is modern form of crazy ideas; differs from real science by lack of integrity, does not follow scientific method
4. Science is a social endeavor; will be difficult even in the future not to fool ourselves; expect failures to continue; keep striving

Step 4.a: Decide on Framing

1. Add introduction (optional)
2. Decide on conclusion

Step 4b: Expand Insights Into Summary

In his Caltech 1974 commencement speech, physics Nobel prize laureate Richard Feynman addresses the graduates on the topic of science and scientific integrity. He discusses crazy ideas, pseudoscience and real science, and the method of science, with the purpose of admonishing graduates to live a life of scientific integrity.

Before science, there were “crazy ideas” (Feynman's words), that is theories about the world that had no scientific basis. A reason is that the scientific method did not yet exist. However, out of crazy ideas not working, men invented the scientific method, which is the process of elimination of ideas not working until only ideas (or theories) remain which we have not yet been proved wrong.

Science then is the human endeavor of discovering the truth by way of appropriate methods, specifically experiments. In experiments, scientists try to answer a question by enacting the effect they have a question about. They do so by trying out all possible variations and circumstances of context that affect the answer to their question, until they can clearly identify a relationship between those circumstances and the observed effects. Science is a process with many unknowns, so it is of utmost importance that the scientist be of highest integrity, which specifically means that he or she report about everything they observe, whether it supports their answers to their question or not.

Despite science and the invention of the scientific method, crazy ideas still exist today in the form of “pseudoscience”. Feynman also calls pseudoscience “cargo cult science”, based on the cargo cult of a people of the South Seas. That people had once experienced superior American technology, which had done them well. When the Americans left, they tried to recreate it by simulating landing airplanes in the form of wooden replicas. Pseudoscience is like the cargo cult: It goes through the motions without proper understanding. It fails to setup the necessary requisites, In short, it does not apply the scientific method properly and lacks integrity.

There are many ways in how honest scientists can fail to apply the scientific method properly. Social pressure is one reason. Science is a social endeavor and we must be aware that what we consider truth today may actually be false, not only because we overlooked something technical or made a mistake, but also because the social context of science leads us to wrong conclusions and to fool ourselves and others. Thus, science or the search for truth is a never ending process.

The Research Cycle [1]

[1] See https://phdcomics.com

Summary

1. Summary purpose
2. Structured analysis
3. Written Summary

Thank you! Any questions?

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