How to Read a Scientific Journal Article

1. Title: Subtitle

The title will contain the topic and thesis of the article. A subtitle, if present, will contain information about the theory, methods, and/or a specific qualification about the data.

2. Authors

Often scientific studies are authored by a group. The order of the authors is important. Authors are ranked in order of contribution to the project, with the person doing the most work listed first to the person doing the least work listed last. However, it is also common to list the most important or famous author first, even if this author contributed little, if anything, to the project. Listing a famous author first adds prestige and authority. Such a practice is frowned upon and considered "non-scientific", but it still happens.

3. Abstract

This is a short summary of the thesis, theory, methods, data collection, discussion, and conclusions. You want to read the abstract first in order to decide if the article fits your own research agenda.

4. Keywords

Some journals provide keywords, which are the official classifications of the topics discussed in the article. You can use these keywords for future research in library card catalogs or journal databases.

5. Introduction: Review of Literature, Research Question, & Hypothesis

All scientific articles begin with a review of the scholarly literature on the topic. The most important research studies will be cited and discussed. The focus will be on explaining the established theory on the topic and the central concepts of that theory. The literature review will point out what is known and what is not known, leading into a discussion of the specific research question and hypothesis of the article you are reading.

6. Data, Data Source, and Sample

Sometimes a discussion of the data is integrated with a discussion of methodology (see #7), and sometimes these two parts of the research process are separated. Scientists will talk about the phenomenon they studied in several important ways. They will discuss how they defined and measured the phenomenon, especially if they are only observing a smaller part of a larger, complex whole. The definition and measurement are often called “the unit of analysis”. Scientists will discuss where they located the phenomenon and if the location might cause some unique bias in the data (for example, one environment might have unique variables that another does not). If scientists study a small sample of a larger population then they must explain how they gathered the sample (for example, 100 rhesus monkeys who are supposed to represent ALL rhesus monkeys). They will also note any unique characteristics, which might “bias” the data by making the phenomenon different than the general population. While every general population will share core similarities, it is also composed of many types of unique individuals. This uniqueness can be caused by genetic factors inside the phenomenon or environmental factors outside of it. Because of this natural variation, Scientists often run a statistical test to determine if the sample matches the characteristics of other sample populations that have already been studied. This is very important information if another scientist later performs a “meta-analysis” of previous studies, which is a way to compare the data and conclusions of many articles all together to make more valid conclusions based on all of the available data. In order to compare previous scientific studies, it is essential that all the studies focused on the exact same population with the exact same characteristics (or very close to being exact); otherwise, if the various samples have too many different unique variables, a comparison could be misleading, like comparing apples and oranges, both fruit, but very different types of fruit.

7. Methodology

Methodology is a contested term across the sciences. This word can refer to many things, so it is important to see how a scientist might be using this word in a unique way for her own research agenda. In most cases, methodology refers to two different but related topics: (1) What tools did a scientist use and how did she use them; and (2) what theory did the scientist use as the logical basis for choosing these specific tools and their use. In most journal articles, the methodology section will focus on the tools a scientist uses and how she used them. This information will be very technical and filled with academic jargon. You will most likely not understand this information unless you have been formally taught about these tools and their use in a university, mostly likely in graduate school. Scientists know that tools and how they are used can bias a study. The right tool must be properly selected for the right job, and the tool must be used correctly. Most of the debate between academics is over methodology, or the tools used to study a phenomenon. Either the wrong tool was used or it was used improperly. Scientific tools consist of three types: (A) Technology, (B) Concepts, and (C) Theories. First, all scientists use various types of “technology,” mechanical or logical tools, in order to conduct a study, from the human eye to video recorders to microscopes or telescopes to mathematical formulas or statistical procedures. Sometimes a specific technology will be invented by a scientist in order to conduct a study. For example, Galileo wanted to study the stars, but the existing telescopes where very crude, so he invented a much more sophisticated tool that allowed him to see phenomena no one had ever seen before. Another kind of tool is the “concept”, or idea. This concept will include a specific definition of a phenomenon, its parts, and its natural environment. It is important for scientists to define phenomenon in the same way so they can know what parts to look for and how these parts fit together. Finally, the last type of tool is a “theory.” A theory is an explanation, usually temporal and casual (cause A produces in time effect B), which describes how several variables interact together, usually under specific circumstances or in a unique environment. A theory is often operationalized into a “model”, which can be expressed with concepts or with mathematics. The model becomes a formal tool with specifically defined variables interacting in specific ways. A scientist uses this model to predict how phenomena should behave when studied. If the variables behave as the theory predicts, then the study confirms the theory. If the variables do not behave as predicted, then either the theory is wrong or the scientist made a mistake, in either case another study would be needed to clarify what happened and why. In most cases, scientific theories are attached to specific theories of methodology (which is the second definition of the word "methodology"). A methodological theory explains how to define and observe variables with specific, "valid" tools. This discussion focuses on "validity," or making sure data and the tools used to collect data are valid, or "true" according to the theory and the objective world. The term validity has two different but related definitions. Valid data, concepts, or methodology are logically coherent and justified under the explanatory power of a specific scientific theory. Validity also has a more philosophical definition. It can mean that the phenomenon being studied objectively exists and that the scientist's concepts and theory accurately represent how the phenomenon exists. Usually, a scientist will not go into this type of depth in most journal articles. Such a discussion is more fitting for specific articles on methodology and theory, which is the specific focus of philosophers of science.

8. Results

The results section will explain the data produced by the study. Scientists will also explain if the data turned out as expected, or if some of the data was unexpected. Unexpected data points to flaws with the theory or possible mistakes made by the scientists. The results section will often be accompanied by lots of charts and graphs, especially statistical tables and graphs. This section is the most important part of a scientific study because it contains all the specific data that the scientist was able to produce.

9. Discussion and Limitations

Scientists will discuss the data in relation to the methodology to explain why the data confirmed the theory, why the data did not confirm the theory, and/or any validity issues in terms of how the data might match up against the larger population in the objective world. There is usually some unexpected data in every scientific study because most theories are not perfect, most sampled phenomenon has unique characteristics, and most scientists make mistakes, so this section usually focuses on those topics. Also, most methodology imperfectly captures the complex nature of phenomenon in the real world, so scientists like to discuss how they were only able to observe a small part of a larger, complex whole. They want to make sure they don't exaggerate what they were able to find, and they want to explain what they still don't know about the phenomenon and why they don't know it. Discussion of the unknown helps future scientists study the same phenomenon in a different, hopefully better way by using more sophisticated theories and methodology.

10. Conclusions

The conclusion section is very similar to the previous section, and sometimes they are combined together. This is the second most important part of the journal article. It explains the specific claims the scientist can make about what is true or false, and it explains how certain the scientist is about the validity of their claims. If the study was successful, then the scientist can make lots of definitive conclusions based on the data and the validity of the theory. But an unsuccessful study produces few, if any, conclusions. The most important conclusion of an unsuccessful study would be a valid explanation about why the study was unsuccessful, which would help future scientists produce a better study.

11. Suggestions for Future Research

Even when an individual scientist is working alone, they are still interacting with the work of tens or hundreds of other scientists who are all working to make the same discoveries, often over years or decades. For an unsuccessful study, scientists will explain what went wrong and how to avoid those mistakes in the future. For a successful study, scientists will explain what they still don't know and how they might be able to make new discoveries. Scientists will also discuss their methodology and how to make their tools work better.

12. Implications for Policy and/or Practice

Not all scientific articles have this section. Some scientific fields have a direct connection to practical activities or political debates. Within these fields, there are many non-scientists who would like to use scientific discoveries for practical purposes. Thus, with this non-scientific audience in mind, the scientist can discuss how their data, results, and conclusions could be used in a practical way, such as explaining how a specific activity or tool might be used by an engineer or educator, or how a specific policy might be created by a lobbyist or politician.

13. Footnotes, Endnotes, and References

Almost every scientific article includes notes and references. If you do not see these tools, then most likely it is not a scientific article. Sometimes an article will appear in a scientific journal without notes and references, but these types of articles are very rare. In such a case, a scientist might be arguing with another scientist or sharing personal opinions. Some academic journals are focused on a general, non-academic audience, so they will leave out notes and references to improve readability in an effort to not alienate the general public. An article without notes and references should be approached cautiously, and rarely, if ever, used as a source in an academic research paper. Remember, science is a team activity. Scientists depend upon the theories, concepts, data, logic, and conclusions of other scientists. All scientists are bound by the professional principle of academic integrity, which means they must cite all the sources they used to complete a study. By citing sources, other scientists can make sure the present study is up to date and is built upon the foundation of the other important scientists studying the same subject. Citing sources also helps the reader find additional information on a topic. If you read an article and want to find more data on the same phenomenon or theory, then simply look at the sources the scientist cited in the article as the first place to start your own research.