A Guide to Critical Argument

"Scientific papers are not just baskets carrying unconnected facts like the telephone directory; they are instruments of persuasion. Scientific papers must argue you into believing what they conclude; they must be built on the principles of critical arguments." (Huth, 1990, p.55)

What is a Critical Argument?

An "argument" is a logically connected series of reasons, statements, or facts (**evidence**) used to support or establish an idea or point of view (a **claim;** see Huth, 1990, p.56). The purpose of argument is to persuade the reader to accept the claim as true, and/or to undertake some action.

To be "critical" is to analyze and evaluate ideas and evidence. The purpose is to understand the strengths and limitations of research, theory or practice for both its stated purpose and your own topic.

Arguments are frameworks designed to help us approach solutions to difficult problems. **Critical argument** allows us to judge the strengths and weaknesses of our options in a logical fashion.

A critical argument is NOT a set of unsupported opinions. For example, the claim that "Pharmacy is the best profession in the world" cannot be argued. It reflects the writer's personal definition of "best," which no amount of evidence could prove. On the other hand, a claim such as "Pharmacists are essential members of the health care team" can be argued—by defining in what ways and to whom pharmacists are essential, and by providing supporting examples.

We can argue **deductively** (start with a general principle and deduce consequences and applications) or **inductively** (start with facts or situations and **infer** a general principle). Another way to understand deductive and inductive reasoning is this:

- in deductive argument, we advance an idea and support it with evidence;
- in inductive argument, we start with the evidence and interpret it to come up with an idea.

Writing that manipulates data technically (such as a lab report) or mathematically (such as statistical analysis) relies on deductive argument. Outside of the realm of mathematical proof, however, most written argument is primarily inductive. In research writing, for example, researchers use statistical analysis to deduce the significance of their results. Then, however, they interpret the evidence (the significance) to argue for a particular answer (e.g., their research hypothesis) to their question or issue. This is an inductive process.

See below for an explanation of the basics of **formal logic**.

Some Features of Well-written Arguments

- They are constructed logically. That is, they are coherent and have a logical flow.
- They have an appropriate balance of ideas and evidence.
- They can be summarized clearly and briefly (e.g., in a thesis statement, or in an abstract).

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Any written argument can be broken down, or "deconstructed," to reveal its logical underpinnings. Here is an example of writing that advances a persuasive and logically structured argument, followed by its deconstruction. It was written by a graduate student seeking renewal of a grant:

My project within the laboratory is to investigate the role of TNFa in aneurysm formation. Specifically, I will determine the role of TNFa in smooth muscle cell apoptosis as a mechanism leading to aneurysm formation. My hypothesis is that TNFa is necessary for development of coronary artery lesions in an animal model of Kawasaki Disease (KD). First, I will delineate the kinetics of TNFa production during disease evolution using real-time reverse-transcriptase polymerase chain reaction. I will also determine the requirement for TNFa in the early immune response, both by using genetically-modified animals with mutations in the TNFa p55 receptor and by using a soluble TNFa receptor to try to ameliorate the disease early in its course, thus mimicking treatment in the acute phase in children with KD. Secondly, I will examine the affected organ (heart) both in a whole animal model and in an *ex-vivo* coronary artery organ culture system to determine the role of TNFa in apoptosis of various vessel wall components. To date, I have mastered the fundamental techniques in basic immunology and basic molecular biology required to answer my research questions, and look forward to exciting results in the near future.

I. Introduction
   1. My project is to investigate the role of TNFa
      1.1 Specifically, I will determine
   2. My hypothesis is

II. Method
   1. First, I will delineate
      1.1 I will also determine
         1.1.1 both by using
         1.1.2 and by using

2. Secondly, I will examine
    2.1 both in
    2.2 and in
    to determine the role of TNFa.

III. Conclusion
1. To date, I have mastered…fundamental…basic…basic
2. and I look forward …exciting…near future.

Arguments have an appropriate balance of claims and evidence. In this sentence, for example:

I. Claim: I will also determine the requirement for TNFa in the early immune response,
II. Evidence (the method): both by using genetically-modified animals with mutations in the TNFa p55 receptor and by using a soluble TNFa receptor to try to ameliorate the disease early in its course.

Arguments can be summarized clearly and briefly (e.g., in a thesis statement, or in an abstract):

I. My research will advance our understanding of Kawasaki Disease in children.
II. My methodology is thorough.
III. I'm ready to get started. Please send money.

Using Language to Build an Argument

We use language to build and strengthen our arguments through

- ***Key words and concepts*** repeated and added to in a logical sequence
- ***Connectors***: transitional words and phrases that establish relationships such as addition, contrast, comparison, causation. Click here for a list of useful **transitions**.

This next example is part of the introduction to a policy analysis. The sentence identifies the main argument (the "central claim") of the paper, and lists the three factors that the analysis focuses on:

In the 1990s, several factors led to a reduction in long-term care services in the Greater Toronto Area: cuts in provincial funding, changes in societal attitudes, and the new market economy.

In the body of the policy analysis, the writer develops the same information into a paragraph that advances an argument. The writer creates a causal chain of argument by repeating the **key words** of the introduction, ***logically connected*** into a sequence of claims and evidence:

In the mid-1990s, the provincial government was influenced by the model of the new market economy *and [addition]* sought a rationale for cutting its funding of social programs. *Thus, [causation]* it took advantage of a recent hardening of societal attitudes to accelerate its cuts to these services. *As a result, [causation]* long-term care services in the GTA were cut by 20% in 1998, *as compared with [comparison]* a 5% cut in 1997.

Final Example

To bring together everything this Guide has said, let's take a weak argument and revise it. This example is the first paragraph of a research report. You'll notice, among its other weaknesses, that it contains **key words** but no ***logical connectors***.

1. During the last few decades the interest in fine particulates has increased dramatically. 2.Many studies have shown that there are negative effects of air pollution on human health. 3.Knowledge is growing about the composition of air pollution, mechanisms of toxicity and susceptible populations. 4. This study is one of the attempts to understand how fine particulates and ozone might interfere with the autonomic regulation of heart.

1. The key concepts of this sentence are vague: what does "dramatically" mean? How long is "a few decades"—twenty years? fifty years? It's okay to be broad in a first sentence, but not vague. "Fine particulates," on the other hand, is too specific for a first sentence.
2. This sentence introduces the broader topic of air pollution and human health, which is good, but it would be better to move from broad to specific (air pollution to fine particulates) rather than from specific to broad.
3. There are specific details in this sentence, which is good, but the reader is left unsure whether the current study is on air pollution or fine particulates. This is also the third sentence in a row that makes vague statements about the literature (interest; many studies; knowledge is growing).
4. In this sentence the writer leaps back to the topic of fine particulates. Meanwhile, both ozone and autonomic regulation of heart appear from nowhere.

Now let's revise. We'll set up a sequence of **key words** and ***logical connectors*** to create a persuasive argument:

1. Many studies (e.g., 1-6) have shown that air pollution has negative effects on human health. 2. *Further,* knowledge is growing about the composition of air pollution, mechanics of toxicity and susceptible populations. 3. *In particular,* a number of recent studies (7-11) have focused on the effects of fine particulates and ozone. 4. *However,* no research has been conducted to link fine particulates and ozone with the autonomic regulation of the heart, *despite* clinical evidence that such a link might exist. 5. *Thus,* this study was designed to explore the mechanisms by which fine particulates and ozone might interfere with autonomic regulation of the heart.

1-3. The key concepts in the first three sentences move logically, from a broad idea (air pollution and human health) to more specific aspects about our understanding of air pollution (composition, toxicity and susceptible populations), to the particular topic of the study (fine particulates and ozone).

4. This sentence identifies (however) a gap in our understanding. It links fine particulates and ozone with the autonomic regulation of the heart. Notice that I've added a rationale for the current research (clinical evidence). The original paragraph didn't offer any reason why we would want to investigate these things.

5. This sentence makes the final links that connect the study with fine particulates/ozone and autonomic regulation of the heart.

Basics of Formal Logic

A **deductive argument** advances from a set problem and will produce a "right" or "wrong" answer (Felder, 1988). The basic form of deductive reasoning is the logical syllogism. Here is a classic example of **sound** logic:

major premise:	All mammals are warm-blooded animals.
minor premise:	Whales are mammals.
conclusion:	Therefore, whales are warm-blooded animals. ✔

In appraising the soundness of a deductive argument, we ask these questions:

- Are all the premises **true** (or do they at least seem to be true)? If one or more of the premises is false, then the conclusion cannot be known to be true on the basis of those premises, even if the logical structure of the argument is valid:

major premise:	All mammals can fly.
minor premise:	Whales are mammals.
conclusion:	Therefore, whales can fly. ✘

- Is the argument logically **valid**? Given the truth of the premises, does the conclusion really follow from the premises? If not, why not?

  major premise: All hospitals have beds.
  minor premise: The Four Seasons Hotel has beds.
  conclusion: Therefore, the Four Seasons Hotel is a hospital.

  This example is a ***non sequitur*** (literally, "it does not follow"). Just because all hospitals have beds, it does not follow that all buildings with beds are hospitals.

In an **inductive argument**, the writer defines the problem, then locates and defends the information that leads us to a "best" solution (Felder, 1988). Whereas deductive reasoning can be used to establish proof, inductive reasoning establishes levels of probability. I might tell you, for example, that I have been a moderate social drinker for 20 years. No one has ever seen me intoxicated. You might conclude that I won't get drunk at the party tonight and you ask me to drive you home. Here, the premises are true and the argument is valid, but the conclusion isn't necessarily true. Maybe tonight's the night I suddenly develop a love of beer. It's highly probable that I'll stay sober, but not certain.

Sources

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