

CRITICAL REASONING AND WRITING



Noah Levin
Golden West College

Book: Critical Reasoning and Writing (Levin et al.)

```
template('CrossTransclude/Web',{ 'Library': 'chem', 'PageID': 170365 });
```

TABLE OF CONTENTS

Licensing

Preface

1: Introduction to Critical Thinking, Reasoning, and Logic

- 1.1: Prelude to Chapter
- 1.2: Introduction and Thought Experiments- The Trolley Problem
- 1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall
- 1.4: Distinction of Proof from Verification; Our Biases and the Forer Effect
- 1.5: The Scientific Method
- 1.6: Diagramming Thoughts and Arguments - Analyzing News Media
- 1.7: Creating a Philosophical Outline

2: Language - Meaning and Definition

- 2.1: Techniques of Defining- "Semantics" vs "Syntax" and Avoiding more Ambiguity
- 2.2: Criteria for Framing Definitions- It's all about Context and Audience
- 2.3: Defining Terms Appropriately
- 2.4: Cognitive and Emotive Meaning - Abortion and Capital Punishment
- 2.5: Functions of Language and Precision in Speech
- 2.6: Defining Terms- Types and Purposes of Definitions

3: Informal Fallacies - Mistakes in Reasoning

- 3.1: Classification of Fallacies - All the Ways we Say Things Wrong
- 3.2: Fallacies of Evidence
- 3.3: Fallacies of Weak Induction
- 3.4: Fallacies of Ambiguity and Grammatical Analogy
- 3.5: The Detection of Fallacies in Ordinary Language
- 3.6: Searching Your Essays for Fallacies

4: Deductive Arguments

- 4.1: Prelude to Deductive Arguments
- 4.2: Statements and Symbolizing
- 4.3: Propositions, Inferences, and Judgments
- 4.4: Validity and Soundness
- 4.5: Common Forms of Arguments
- 4.6: Formal Fallacies
- 4.7: Formalizing your Arguments

5: Inductive Arguments

- 5.1: Prelude to Inductive Arguments
- 5.2: Cogency and Strong Arguments
- 5.3: Causality and Scientific Reasoning
- 5.4: Analogy
- 5.5: Statistical Reasoning- Bayes' Theorem
- 5.6: Legal Reasoning and Moral Reasoning
- 5.7: Editing Your Final Essay

[Index](#)

[Glossary](#)

[Detailed Licensing](#)

Licensing

A detailed breakdown of this resource's licensing can be found in [Back Matter/Detailed Licensing](#).

Preface

Licensing Information

Unless otherwise noted, all content contained herein is either not under copyright in the United States (primarily due to the expiration of the copyright) or the work has been released into the Public Domain by the author. All content is under a license that allows this work in its entirety to be reproduced and reprinted, but not for commercial purposes. Due to licenses that apply to certain sections of this book, it is safest to presume this work as a whole to be under a CC-BY-NC-ND license.

How to Cite this Work

When citing this work, please make sure that this conforms to the rules for citing an edited volume in your citation style. For APA style, all you simply need to use is “Levin, N. (Ed). (2019). Critical Reasoning and Writing: An Open Educational Resource. N.G.E. Far Press.” Remember that the author(s) of every piece in this work are noted, and if there is none listed, then it is the work of the editor. To cite a specific chapter, use the citation information listed in the footnote at the beginning of the chapter and include it as being from this volume (if desired, and as appropriate to your style). For example, to cite Chapter 2 in this work for APA style, you would use, “DiGiovanna, J. (2013). Introduction to Critical Thinking. In Levin, N. (Ed). (2019). Critical Reasoning and Writing: An Open Educational Resource. N.G.E. Far Press.”

You can find all my works available wherever there is a desire to read them. And for FREE here:

NGE Far Press

A Phony Publisher for Real Works <http://www.ngefarpress.com>

You can contact the author at the above website or at nlevin@gwc.cccd.edu Critical Reasoning and Writing: An Open Educational Resource

Collected and Edited by Noah Levin, PhD

Golden West College Huntington Beach, CA Last Revision: January, 2019 Originally Released August, 2018

CHAPTER OVERVIEW

1: Introduction to Critical Thinking, Reasoning, and Logic

What is thinking? It may seem strange to begin a logic textbook with this question. ‘Thinking’ is perhaps the most intimate and personal thing that people do. Yet the more you ‘think’ about thinking, the more mysterious it can appear. It is the sort of thing that one intuitively or naturally understands, and yet cannot describe to others without great difficulty. Many people believe that logic is very abstract, dispassionate, complicated, and even cold. But in fact the study of logic is nothing more intimidating or obscure than this: the study of good thinking.

[1.1: Prelude to Chapter](#)

[1.2: Introduction and Thought Experiments- The Trolley Problem](#)

[1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall](#)

[1.4: Distinction of Proof from Verification; Our Biases and the Forer Effect](#)

[1.5: The Scientific Method](#)

[1.6: Diagramming Thoughts and Arguments - Analyzing News Media](#)

[1.7: Creating a Philosophical Outline](#)

This page titled [1: Introduction to Critical Thinking, Reasoning, and Logic](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#) .

1.1: Prelude to Chapter

Critical Thinking¹

“Thinking ... is no more and no less an organ of perception than the eye or ear. Just as the eye perceives colours and the ear sounds, so thinking perceives ideas.” – Rudolph Steiner.

What is thinking? It may seem strange to begin a logic textbook with this question. ‘Thinking’ is perhaps the most intimate and personal thing that people do. Yet the more you ‘think’ about thinking, the more mysterious it can appear. It is the sort of thing that one intuitively or naturally understands, and yet cannot describe to others without great difficulty. Many people believe that logic is very abstract, dispassionate, complicated, and even cold. But in fact the study of logic is nothing more intimidating or obscure than this: the study of good thinking.

Before asking what good thinking is, we might want to ask a few questions about thinking as such. Let’s say that thinking is the activity of the mind. It includes activities like reasoning, perceiving, explaining, inventing, problem solving, learning, teaching, contemplating, knowing, and even dreaming. We think about everything, all the time. We think about ordinary practical matters like what to have for dinner tonight, all the way to the most abstract and serious matters, like the meaning of life. You are thinking, right now, as you read this sentence.

Some may wish to draw a distinction between thinking and feeling, including sense perception, emotional experience, or even religious faith. Some might want to argue that computers or animals are capable of thinking, even if their way of thinking is somehow different from that of humans. And some might say that the question is an absurd one: everyone knows what thinking is, because everyone ‘thinks’ all the time, and everyone can ‘feel’ themselves thinking. We are somehow ‘aware’ of thoughts in our minds, aware of information and knowledge, aware of memories, and aware of likely future probabilities and so on. Thinking is a first-order phenomenological insight: it’s a bit like knowing what the colour ‘red’ looks like, or knowing the taste of an orange. You know what it is, but you probably have an awfully hard time describing or defining it.

Thinking, in this way of ‘thinking’ about thinking, is an *event*. It is something *done*, something that *takes place*, and something that *happens*.

There are a lot of serious philosophical (as well as scientific) questions about the nature of thinking. For instance, we might ask: ‘*who is it that knows that he or she knows?*’ Who is it that is aware of thinking? And is not that awareness of thinking itself a kind of thinking? This is a line of questioning that may seem as if it can go on forever. It’s a little bit beyond the purpose of this book to investigate all of them. But if you happen to find yourself asking how do you know that you know something, or if you find yourself thinking about the nature of thinking itself, you may be well on your way toward becoming an excellent philosopher!

Why is good thinking important?

A lot of people think of philosophy as something rather vague, wishy-washy, or simplistic. You’ll hear people quote a line from a popular song or movie, and then they’ll say, “That’s my philosophy.” But there’s a lot more to it than that; and a person who merely repeats a popular saying and calls it philosophy has not been doing enough work. Philosophical questions are often very *difficult* questions, and they demand a lot of effort and consideration and time.

Good and bad thinking are very different from each other. Yet some people might feel personally threatened by this distinction. Your thoughts are probably the most intimate and the most precious of all your possessions. Your mind, indeed, is the only part of you that is truly ‘yours’, and cannot be taken away from you. Thus if someone tells you that your thinking is muddled, confused, unclear, or just plain mistaken, then you might feel very hurt or very offended.

But your thinking certainly can be muddled or confused. Normally, bad quality thinking happens when your mind has been ‘possessed’, so to speak, by other people and made to serve their purposes instead of your own. This can happen in various ways.

In your life so far, you have gathered a lot of beliefs about a lot of different topics. You believe things about who you are, what the world is like, where you belong in the world, and what to do with your life. You have beliefs about what is good music and bad music, what kind of movies are funny and what kind are boring, whether it’s right or wrong to get a tattoo, whether the police can be trusted, whether or not there is a god, and so on. These beliefs came from somewhere. Most of you probably gathered your most important beliefs during your childhood. You learned them from your family, especially your parents, your teachers at school, your piano instructor or your karate instructor, your scout group or guide group leader, your priest, your medical doctor, your friends, and just about anybody who had any kind of influence on your life. There is nothing wrong with learning things from other people this way; indeed, we probably couldn’t get much of a start in life without this kind of influence. But if you have accepted your

beliefs from these sources, and not done your own thinking about them, then they are not your beliefs, and you are not truly thinking your own thoughts. They are, instead, someone else's thoughts and beliefs, occupying your mind. If you believe something only because someone else taught it to you, and not because you examined those beliefs on your own, then in an important sense, you are not having your own thoughts. And if you are not having your own thoughts, then you are not living your own life, and you are not truly free.

Some people might resist studying logic for other reasons. They may prefer to trust their intuition or their "gut feelings" as a source of knowledge. I'm always very curious about such people. Perhaps they think that logic is dispassionate and unemotional, and that logical people end up cold-hearted and emotionless, like robots. Perhaps they find their intuitive beliefs so gratifying that they cannot allow anything to interfere with them. Perhaps they worry that they may have to re-evaluate their beliefs and their lives, and perhaps change their lives as a result of that re-evaluation. Those things may be true for some people, if not for all of them. But when your beliefs are grounded in reason, the quality of your inner life will be far, far better, in ways like these:

You will be in greater conscious control of your own mind and thoughts. It will be harder for advertising, political propaganda, peer pressure, scams and confidence tricks, or other forms of psychological manipulation to affect you. When your actions or motives are questioned, you will be much better able to explain yourself effectively and persuasively. You will be able to understand difficult, complex, and challenging ideas a lot easier, and with a lot less anxiety. You will be able to understand things in a more comprehensive and complete way. You will be better able to identify the source of your problems, whether practical or personal, and better able to handle or solve those problems. You will feel much less frustrated or upset when you come across something that you do not understand. You will be better able to plan for the future, compete for better paying or more prestigious jobs, and to gather political power. You will find it easier to stand up to governments, employers, and other authorities when they act unjustly. Tragedies, bad fortune, stress, and other problems in life will be easier to deal with. You will find it easier to understand other people's feelings and other people's points of view, and you will be better able to help prevent those differences from becoming conflicts. You will get much more pleasure and enjoyment from the arts, music, poetry, science, and culture. You may even enjoy life more than you otherwise would.

Argument²

In philosophy and logic, an argument is a series of statements typically used to persuade someone of something or to present reasons for accepting a conclusion. The general form of an argument in a natural language is that of premises (typically in the form of propositions, statements or sentences) in support of a claim: the conclusion. The structure of some arguments can also be set out in a formal language, and formally defined "arguments" can be made independently of natural language arguments, as in math, logic, and computer science.

In a typical deductive argument, the premises *guarantee* the truth of the conclusion, while in an inductive argument, they are thought to provide reasons supporting the conclusion's *probable* truth. The standards for evaluating non-deductive arguments may rest on different or additional criteria than truth, for example, the persuasiveness of so-called "indispensability claims" in transcendental arguments, the quality of hypotheses in retrodution, or even the disclosure of new possibilities for thinking and acting.

The standards and criteria used in evaluating arguments and their forms of reasoning are studied in logic. Ways of formulating arguments effectively are studied in rhetoric (see also: argumentation theory). An argument in a formal language shows the logical form of the symbolically represented or natural language arguments obtained by its interpretations.

Formal and informal

Informal arguments as studied in *informal logic*, are presented in ordinary language and are intended for everyday discourse. Conversely, formal arguments are studied in *formal logic* (historically called *symbolic logic*, more commonly referred to as *mathematical logic* today) and are expressed in a formal language. Informal logic may be said to emphasize the study of argumentation, whereas formal logic emphasizes implication and inference. Informal arguments are sometimes implicit. That is, the rational structure – the relationship of claims, premises, warrants, relations of implication, and conclusion – is not always spelled out and immediately visible and must sometimes be made explicit by analysis.

Standard types

There are several kinds of arguments in logic, the best-known of which are "deductive" and "inductive." An argument has one or more premises but only one conclusion. Each premise and the conclusion are truth bearers or "truth-candidates", each capable of being either true or false (but not both). These truth values bear on the terminology used with arguments.

Deductive arguments

- A deductive argument asserts that the truth of the conclusion is a logical consequence of the premises. Based on the premises, the conclusion follows necessarily (with certainty). For example, given premises that $A=B$ and $B=C$, then the conclusion follows necessarily that $A=C$. Deductive arguments are sometimes referred to as "truth-preserving" arguments.
- A deductive argument is said to be valid or invalid. If one *assumes* the premises to be true (ignoring their actual truth values), would the conclusion follow with certainty? If yes, the argument is valid. Otherwise, it is invalid. In determining validity, the structure of the argument is essential to the determination, not the actual truth values. For example, consider the argument that because bats can fly (premise=true), and all flying creatures are birds (premise=false), therefore bats are birds (conclusion=false). If we assume the premises are true, the conclusion follows necessarily, and thus it is a valid argument.
- If a deductive argument is valid and its premises are all true, then it is also referred to as sound. Otherwise, it is unsound, as in the "bats are birds" example.

Inductive arguments

- An inductive argument, on the other hand, asserts that the truth of the conclusion is supported to some degree of probability by the premises. For example, given that the U.S. military budget is the largest in the world (premise=true), then it is probable that it will remain so for the next 10 years (conclusion=true). Arguments that involve predictions are inductive, as the future is uncertain.
- An inductive argument is said to be strong or weak. If the premises of an inductive argument are *assumed* true, is it probable the conclusion is also true? If so, the argument is strong. Otherwise, it is weak.
- A strong argument is said to be cogent if it has all true premises. Otherwise, the argument is uncogent. The military budget argument example above is a strong, cogent argument.

Deductive

A *deductive argument* is one that, if valid, has a conclusion that is entailed by its premises. In other words, the truth of the conclusion is a logical consequence of the premises—if the premises are true, then the conclusion must be true. It would be self-contradictory to assert the premises and deny the conclusion, because the negation of the conclusion is contradictory to the truth of the premises.

Validity

Deductive arguments may be either valid or invalid. If an argument is valid, it is a valid deduction, and if its premises are true, the conclusion must be true: a valid argument cannot have true premises and a false conclusion.

An argument is formally valid if and only if the denial of the conclusion is incompatible with accepting all the premises.

The validity of an argument depends, however, not on the actual truth or falsity of its premises and conclusion, but solely on whether or not the argument has a valid logical form. The validity of an argument is not a guarantee of the truth of its conclusion. Under a given interpretation, a valid argument may have false premises that render it inconclusive: the conclusion of a valid argument with one or more false premises may be either true or false.

Logic seeks to discover the valid forms, the forms that make arguments valid. A form of argument is valid if and only if the conclusion is true under all interpretations of that argument in which the premises are true. Since the validity of an argument depends solely on its form, an argument can be shown to be invalid by showing that its form is invalid. This can be done by giving a counter example of the same form of argument with premises that are true under a given interpretation, but a conclusion that is false under that interpretation. In informal logic this is called a counter argument.

The form of argument can be shown by the use of symbols. For each argument form, there is a corresponding statement form, called a corresponding conditional, and an argument form is valid if and only if its corresponding conditional is a logical truth. A statement form which is logically true is also said to be a valid statement form. A statement form is a logical truth if it is true under all interpretations. A statement form can be shown to be a logical truth by either (a) showing that it is a tautology or (b) by means of a proof procedure.

The corresponding conditional of a valid argument is a necessary truth (*true in all possible worlds*) and so the conclusion necessarily follows from the premises, or follows of logical necessity. The conclusion of a valid argument is not necessarily true, it depends on whether the premises are true. If the conclusion, itself, just so happens to be a necessary truth, it is so without regard to the premises.

Some examples:

- *All Greeks are human and all humans are mortal; therefore, all Greeks are mortal.* : Valid argument; if the premises are true the conclusion must be true.
- *Some Greeks are logicians and some logicians are tiresome; therefore, some Greeks are tiresome.* Invalid argument: the tiresome logicians might all be Romans (for example).
- *Either we are all doomed or we are all saved; we are not all saved; therefore, we are all doomed.* Valid argument; the premises entail the conclusion. (Remember that this does not mean the conclusion has to be true; it is only true if the premises are true, which they may not be!)
- *Some men are hawkers. Some hawkers are rich. Therefore, some men are rich.* Invalid argument. This can be easier seen by giving a counter-example with the same argument form:
- *Some people are herbivores. Some herbivores are zebras. Therefore, some people are zebras.* Invalid argument, as it is possible that the premises be true and the conclusion false.

In the above second to last case (Some men are hawkers...), the counter-example follows the same logical form as the previous argument, (Premise 1: "Some X are Y." Premise 2: "Some Y are Z." Conclusion: "Some X are Z.") in order to demonstrate that whatever hawkers may be, they may or may not be rich, in consideration of the premises as such. (*See also, existential import*).

The forms of argument that render deductions valid are well-established, however some invalid arguments can also be persuasive depending on their construction (inductive arguments, for example). (*See also, formal fallacy and informal fallacy*).

Soundness

A sound argument is a valid argument whose conclusion follows from its premise(s), and the premise(s) of which is/are true.

Inductive

Non-deductive logic is reasoning using arguments in which the premises support the conclusion but do not entail it. Forms of non-deductive logic include the statistical syllogism, which argues from generalizations true for the most part, and induction, a form of reasoning that makes generalizations based on individual instances. An inductive argument is said to be *cogent* if and only if the truth of the argument's premises would render the truth of the conclusion probable (i.e., the argument is *strong*), and the argument's premises are, in fact, true. Cogency can be considered inductive logic's analogue to deductive logic's "soundness." Despite its name, mathematical induction is not a form of inductive reasoning. The lack of deductive validity is known as the problem of induction.

Defeasible arguments and argumentation schemes

In modern argumentation theories, arguments are regarded as defeasible passages from premises to a conclusion. Defeasibility means that when additional information (new evidence or contrary arguments) is provided, the premises may no longer lead to the conclusion (non-monotonic reasoning). This type of reasoning is referred to as defeasible reasoning. For instance we consider the famous Tweedy example:

Tweedy is a bird.

Birds generally fly.

Therefore, Tweedy (probably) flies.

This argument is reasonable and the premises support the conclusion unless additional information indicating that the case is an exception comes in. If Tweedy is a penguin, the inference is no longer justified by the premise. Defeasible arguments are based on generalizations that hold only in the majority of cases, but are subject to exceptions and defaults. In order to represent and assess defeasible reasoning, it is necessary to combine the logical rules (governing the acceptance of a conclusion based on the acceptance of its premises) with rules of material inference, governing how a premise can support a given conclusion (whether it is reasonable or not to draw a specific conclusion from a specific description of a state of affairs). Argumentation schemes have been developed to describe and assess the acceptability or the fallaciousness of defeasible arguments. Argumentation schemes are stereotypical patterns of inference, combining semantic-ontological relations with types of reasoning and logical axioms and representing the abstract structure of the most common types of natural arguments. The argumentation schemes provided in (Walton, Reed & Macagno, 2008) describe tentatively the patterns of the most typical arguments. However, the two levels of abstraction are not distinguished. For this reason, under the label of "argumentation schemes" fall indistinctly patterns of reasoning such as the

abductive, analogical, or inductive ones, and types of argument such as the ones from classification or cause to effect. A typical example is the argument from expert opinion, which has two premises and a conclusion.

Source E is an expert in subject domain S containing proposition A. E asserts that proposition A is true (false). A is true (false).

Each scheme is associated to a set of critical questions, namely criteria for assessing dialectically the reasonableness and acceptability of an argument. The matching critical questions are the standard ways of casting the argument into doubt.

Expertise Question. How credible is E as an expert source? Field Question. Is E an expert in the field that A is in? Opinion Question. What did E assert that implies A? Trustworthiness Question. Is E personally reliable as a source? Consistency Question. Is A consistent with what other experts assert? Backup Evidence Question. Is E's assertion based on evidence?

If an expert says that a proposition is true, this provides a reason for tentatively accepting it, in the absence of stronger reasons to doubt it. But suppose that evidence of financial gain suggests that the expert is biased, for example by evidence showing that he will gain financially from his claim.

By analogy

Argument by analogy may be thought of as argument from the particular to particular. An argument by analogy may use a particular truth in a premise to argue towards a similar particular truth in the conclusion. For example, if A. Plato was mortal, and B. Socrates was like Plato in other respects, then asserting that C. Socrates was mortal is an example of argument by analogy because the reasoning employed in it proceeds from a particular truth in a premise (Plato was mortal) to a similar particular truth in the conclusion, namely that Socrates was mortal.

Other kinds

Other kinds of arguments may have different or additional standards of validity or justification. For example, Charles Taylor writes that so-called transcendental arguments are made up of a "chain of indispensability claims" that attempt to show why something is necessarily true based on its connection to our experience, while Nikolas Kompridis has suggested that there are two types of "fallible" arguments: one based on truth claims, and the other based on the time-responsive disclosure of possibility (see world disclosure). The late French philosopher Michel Foucault is said to have been a prominent advocate of this latter form of philosophical argument.

In informal logic

Argument is an informal calculus, relating an effort to be performed or sum to be spent, to possible future gain, either economic or moral. In informal logic, an argument is a connexion between

1. an *individual* action
2. through which a *generally accepted* good is obtained.

Ex :

1. You should marry Jane (individual action, individual decision)
2. because she has the same temper as you. (generally accepted wisdom that marriage is good in itself, and it is generally accepted that people with the same character get along well).
1. You should not smoke (individual action, individual decision)
2. because smoking is harmful (generally accepted wisdom that health is good).

The argument is neither a) *advice* nor b) *moral or economical judgement*, but the connection between the two. An argument always uses the connective because. An argument is not an explanation. It does not connect two events, cause and effect, which already took place, but a possible individual action and its beneficial outcome. An argument is not a proof. A proof is a logical and cognitive concept; an argument is a praxeologic concept. A proof changes our knowledge; an argument compels us to act.^[1]

Logical status

Argument does not belong to logic, because it is connected to a real person, a real event, and a real effort to be made.

1. If you, John, will buy this stock, it will become twice as valuable in a year.
2. If you, Mary, study dance, you will become a famous ballet dancer.

The value of the argument is connected to the immediate circumstances of the person spoken to. If, in the first case,(1) John has no money, or will die the next year, he will not be interested in buying the stock. If, in the second case (2) she is too heavy, or too old,

she will not be interested in studying and becoming a dancer. The argument is not logical, but profitable.

World-disclosing

World-disclosing arguments are a group of philosophical arguments that are said to employ a disclosive approach, to reveal features of a wider ontological or cultural-linguistic understanding – a "world," in a specifically ontological sense – in order to clarify or transform the background of meaning and "logical space" on which an argument implicitly depends.

Explanations

While arguments attempt to show that something was, is, will be, or should be the case, explanations try to show *why* or *how* something is or will be. If Fred and Joe address the issue of *whether* or not Fred's cat has fleas, Joe may state: "Fred, your cat has fleas. Observe, the cat is scratching right now." Joe has made an *argument that* the cat has fleas. However, if Joe asks Fred, "Why is your cat scratching itself?" the explanation, "...because it has fleas." provides understanding.

Both the above argument and explanation require knowing the generalities that a) fleas often cause itching, and b) that one often scratches to relieve itching. The difference is in the intent: an argument attempts to settle whether or not some claim is true, and an explanation attempts to provide understanding of the event. Note, that by subsuming the specific event (of Fred's cat scratching) as an instance of the general rule that "animals scratch themselves when they have fleas", Joe will no longer wonder *why* Fred's cat is scratching itself. Arguments address problems of belief, explanations address problems of understanding. Also note that in the argument above, the statement, "Fred's cat has fleas" is up for debate (i.e. is a claim), but in the explanation, the statement, "Fred's cat has fleas" is assumed to be true (unquestioned at this time) and just needs *explaining*.

Arguments and explanations largely resemble each other in rhetorical use. This is the cause of much difficulty in thinking critically about claims. There are several reasons for this difficulty.

- People often are not themselves clear on whether they are arguing for or explaining something.
- The same types of words and phrases are used in presenting explanations and arguments.
- The terms 'explain' or 'explanation,' et cetera are frequently used in arguments.
- Explanations are often used within arguments and presented so as to serve *as arguments*.
- Likewise, "...arguments are essential to the process of justifying the validity of any explanation as there are often multiple explanations for any given phenomenon."

Explanations and arguments are often studied in the field of Information Systems to help explain user acceptance of knowledge-based systems. Certain argument types may fit better with personality traits to enhance acceptance by individuals.

Fallacies and nonarguments

Fallacies are types of argument or expressions which are held to be of an invalid form or contain errors in reasoning. There is not as yet any general theory of fallacy or strong agreement among researchers of their definition or potential for application but the term is broadly applicable as a label to certain examples of error, and also variously applied to ambiguous candidates.

In Logic types of fallacy are firmly described thus: First the premises and the conclusion must be statements, capable of being true or false. Secondly it must be asserted that the conclusion follows from the premises. In English the words *therefore*, *so*, *because* and *hence* typically separate the premises from the conclusion of an argument, but this is not necessarily so. Thus: *Socrates is a man, all men are mortal therefore Socrates is mortal* is clearly an argument (a valid one at that), because it is clear it is asserted that *Socrates is mortal* follows from the preceding statements. However *I was thirsty and therefore I drank* is NOT an argument, despite its appearance. It is not being claimed that *I drank* is logically entailed by *I was thirsty*. The *therefore* in this sentence indicates *for that reason not it follows that*.

Elliptical arguments

Often an argument is invalid because there is a missing premise—the supply of which would render it valid. Speakers and writers will often leave out a strictly necessary premise in their reasonings if it is widely accepted and the writer does not wish to state the blindingly obvious. Example: *All metals expand when heated, therefore iron will expand when heated*. (Missing premise: iron is a metal). On the other hand, a seemingly valid argument may be found to lack a premise – a 'hidden assumption' – which if highlighted can show a fault in reasoning. Example: A witness reasoned: *Nobody came out the front door except the milkman; therefore the murderer must have left by the back door*. (Hidden assumptions- the milkman was not the murderer, and the murderer has left by the front or back door).

1.1: Prelude to Chapter is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by LibreTexts.

1.2: Introduction and Thought Experiments- The Trolley Problem

Arguments³

The goal of a critical thinking course is to enable you to understand and analyze arguments. By the end of the course you should be able to recognize such arguments and determine if they are good (i.e. if a rational person, upon hearing such an argument, should be convinced by it.)

1. Basics of Argumentation

Argument: An attempt to convince, using reasons⁴. An argument consists of two parts:

A conclusion, which is the sentence that the argument is arguing for, or that part of the argument that the arguer is trying to convince you of. The conclusion is always a claim.

The premises. These are sentences that are supposed to support, lead to, provide evidence for, prove or convince that the conclusion is true. An argument is an attempt to convince someone (though not necessarily someone in particular) that a certain claim is true.

For example, this is an argument:

Mr. Johnson's fingerprints, and only Mr. Johnson's fingerprints, were found at the crime scene. A knife was found on Mr. Johnson's person, and it matched the wounds on the victim, and contained traces of the victim's blood. Mr. Johnson's cellmate testified that Mr. Johnson confessed to the crime, and hidden cameras recorded this confession. Therefore, Mr. Johnson is guilty.

The last sentence is the conclusion. The other sentences are premises. Here's another:

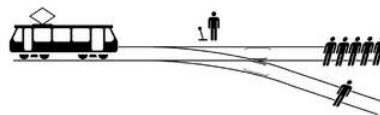
When I left the house there was cake in the refrigerator. You're the only other person with a key to the house, and now the cake is gone. So you ate the cake.

Again, the last sentence is the conclusion, the others are premises. Here's another:

You should complete your college education. People who graduate from college not only earn, on average, more money than college dropouts, they also report much higher levels of satisfaction in life.

In this case, the first sentence is the conclusion, and the rest are premises. You should be able to note this because the other sentences *give reasons that you should accept the first sentence*. That is, they act as premises, or evidence, for the conclusion. Another way to see that this is the conclusion is to ask yourself: what is the person trying to convince me of? It's not "college graduates earn more money." He's telling me that without any evidence. But, if that's true, *that's a reason to graduate from college*. In other words, it's a premise. The premise is presented as evidence for the conclusion.

The Trolley Problem⁵



The trolley problem: should you pull the lever to divert the runaway trolley onto the side track?

The trolley problem is a thought experiment in ethics. The general form of the problem is this: There is a runaway trolley barreling down the railway tracks. Ahead, on the tracks, there are five people tied up and unable to move. The trolley is headed straight for them. You are standing some distance off in the train yard, next to a lever. If you pull this lever, the trolley will switch to a different set of tracks. However, you notice that there is one person on the side track. You have two options: (1) Do nothing, and the trolley kills the five people on the main track. (2) Pull the lever, diverting the trolley onto the side track where it will kill one person. Which is the most ethical choice?

The modern form of the problem was first introduced by Philippa Foot in 1967, but also extensively analyzed by Judith Thomson, Frances Kamm, and Peter Unger. However an earlier version, in which the one person to be sacrificed on the track was the switchman's child, was part of a moral questionnaire given to undergraduates at the University of Wisconsin in 1905, and the German Hans Welzel discussed a similar problem in 1951. Outside of the domain of traditional philosophical discussion, the trolley problem has been a significant feature in the fields of cognitive science and, more recently, of neuroethics. It has also been a topic

in popular books dealing with human psychology. The problem is also discussed with regards to the ethics of the design of autonomous vehicles.

Overview

Foot's original structure of the problem ran as follows:

Suppose that a judge or magistrate is faced with rioters demanding that a culprit be found for a certain crime and threatening otherwise to take their own bloody revenge on a particular section of the community. The real culprit being unknown, the judge sees himself as able to prevent the bloodshed only by framing some innocent person and having him executed. Beside this example is placed another in which a pilot whose airplane is about to crash is deciding whether to steer from a more to a less inhabited area. To make the parallel as close as possible it may rather be supposed that he is the driver of a runaway tram which he can only steer from one narrow track on to another; five men are working on one track and one man on the other; anyone on the track he enters is bound to be killed. In the case of the riots the mob have five hostages, so that in both examples the exchange is supposed to be one man's life for the lives of five.

A utilitarian view asserts that it is obligatory to steer to the track with one man on it. According to simple utilitarianism, such a decision would be not only permissible, but, morally speaking, the better option (the other option being no action at all). An alternate viewpoint is that since moral wrongs are already in place in the situation, moving to another track constitutes a participation in the moral wrong, making one partially responsible for the death when otherwise no one would be responsible. An opponent of action may also point to the incommensurability of human lives. Under some interpretations of moral obligation, simply being present in this situation and being able to influence its outcome constitutes an obligation to participate. If this is the case, then deciding to do nothing would be considered an immoral act if one values five lives more than one.

This page titled [1.2: Introduction and Thought Experiments- The Trolley Problem](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall

Claims⁶

Only certain sorts of sentences can be used in arguments. We call these sentences **propositions**, **statements** or **claims**.

Statements or claims have the following characteristics:

- They are either true or false.
- They are declarative (that is to say, they are not questions or commands; they are sentences that describe how things are, were, will be, would be, could be or should be.)
- They are clearly written or stated such that there is no ambiguity as to their meaning (i.e. they don't have two or more highly distinct interpretations, as in sentences like "I saw the waiter with the glasses") and they are not so vague as to make it impossible to say under what conditions they would be true.
- There are lots of ways for a sentence to fail to be a claim, just as there are a lot of way for a sentence to fail to be a question, or description of a dog, or a command.

Example 1.3.1

Which of the following are claims:

1. All dogs have four legs.
2. John F. Kennedy was the 35th president of the United States.
3. Don't go into Central Park at night.
4. Why do people always talk on their cell phones on the J train?
5. Barack Obama is very tall.
6. There is life on other planets.

Solution

1. Is a claim. It's false (there are dogs that have lost a leg, thus three-legged dogs.) The fact that it's false means that *it must be a claim*. ONLY claims can be false.
2. Is a claim. It's true. The fact that it's true means that it *must be a claim*. ONLY claims can be true.
3. Not a claim. It is a command; it is neither true nor false (though it might be good advice.)
4. Not a claim. It is a question. Questions are never true or false, though sometimes they *imply* claims.
5. Not a claim. "Very tall" is too vague. We have no standard, agreed upon method for determining if someone is "very tall." By Danish standards (where the average male height is 5'11") Obama is probably not "very" tall. By Vietnamese standards (where the average male is 5'4") Obama might well be considered "very" tall. We could turn this sentence into a claim by changing it to "President Obama is 6'2" tall."
6. This is a claim, but we don't know if it's true or not. Still, it's clearly *either* true or false, so it must be a claim.

Subjective and Objective claims

Claims are either *subjective* or *objective*. These words have a special, technical sense in philosophy. A claim is subjective if it is *about* thoughts, feelings, or other internal states of the mind. A claim is objective if it is *about* something that is not dependent on a state of the mind. It's important to keep in mind that you might have used "subjective" and "objective" differently from this, and like all words these have multiple senses. For our purposes, though, we'll be using subjective and objective only of claims, because only claims are true or false, and here subjective and objective describe something about the truth conditions for a claim.

evidence, that is, reason to believe it is snowing. But it's the actual falling snow that makes the claim true, and is the claim's truth condition. One way to think of this is on the analogy of a court of law. You could be on a jury and hear testimony and see evidence that convinces you that the defendant is guilty of the crime. But your belief that "Mr. Johnson murdered Mr. Ono" comes from the evidence, the truth of the claim comes from Mr. Johnson actually having murdered Mr. Ono. You could, in other words, have compelling evidence but be wrong. In fact, it's possible that no one will ever know if Mr. Johnson murdered Mr. Ono (perhaps Mr. Johnson blacked out and lost memory of what occurred during Mr. Ono's death), but the claim is true or false regardless of who believes it. The claims "Mr. Johnson murdered Mr. Ono," and "it is snowing right now outside my window" are objective claims because their truth conditions are not found in anyone's thoughts of feelings or mental content; they exist independently of what anyone thinks or feels.

Whereas, for example, “I’m itchy,” is a subjective claim. “I feel hot,” “John is tired,” “Anita loves Keyshawn,” “Thomas believes in God,” and “The Black Keys are my favorite band,” are all subjective claims. This is because their *truth or falsity* depends upon what someone thinks or feels, or, we can say, the truth conditions for these claims are found in someone’s mental content. If I say, “I feel nauseated,” that claim is true if, and only if, I actually have the feeling of nausea, and false if, and only if, I do not have that feeling. So if I’m trying to get out of doing something, I might say “I feel nauseated” when I had no such feeling, that is to say, when the truth condition does not exist.

The following claims are objective: “Dan is six feet tall,” “The Empire state building is made of cheese,” “New York is the largest city in the United States,” and “God exists.” In each of these cases, though I might have a subjective belief about the claim, the actual truth condition is external to my thoughts and feelings.

Note that the second claim is a *false* objective claim. The Empire State Building is not made of cheese. But the *truth or falsity* of the claim is independent of what anyone thinks or feels. It’s a fact about the world outside of our minds. Similarly, “God exists” is an objective claim. Some people believe it to be true, some people believe it to be false, but their beliefs do not make the claim true or false any more than one’s belief that New York is the largest city in the world would make that claim true. God exists, or fails to exist, whether or not we believe or think that God exists. However, if I said, “I believe that God exists,” that would be a subjective claim. In fact, any objective claim can be turned into a subjective claim by prefixing the words “I think that...” or “I believe that...” to it. That’s because the truth conditions for “I believe there is butter in the refrigerator” are found in my (and only my) beliefs, regardless of whether there is butter in the refrigerator, whereas the claim “there is butter in the refrigerator” is true if, and only if, there is butter in the refrigerator, regardless of what I believe.

Notably, truth is a very complex philosophical topic, and there are interesting disputes about its nature. But at the basic level, pretty much everyone working on the topic agrees that the claim “there is a dog on my bed,” is true if and only if there is a dog on my bed. That is, there is general agreement about the need for truth conditions (which, minimally, means that there is always some difference between a true claim and a false claim.) For our purposes, then, we’ll divide claims up as subjective or objective depending on the nature of their truth conditions.

For the following claims, say if they are subjective or objective:

1. There are over 1200 species of beetles in the world today.
2. The Yankees will win the World Series in 2034.
3. Alissa’s head hurts.
4. I’m tired of hearing about the economy.
5. There is no God but Allah and Mohammed is his prophet.
6. There are over 9 billion people living in Brooklyn.

Answers: 1 is an objective claim. 2 is also objective: though it refers to a future event, it’s not the case that our thoughts or feelings can make it true or false; we just have to wait to see if it’s true or false. Its truth conditions will be independent of thought or feeling. Some hold that it is temporarily neither true nor false; most philosophers, though, hold that claims about the future are true or false but that the truth conditions are simply placed at a different point in time from the claim’s utterance. 3 is subjective: it refers to a feeling that Alissa has. 4 is subjective; it refers to a feeling or thought had by the speaker. 5 is objective: many people believe it to be true, many others do not, but it’s true if and only if there is, in fact, one God, that God’s name is Allah, and Mohammed is the prophet of that God. My thoughts or feelings on this cannot alter its truth value. 6 is objective: there are not, in fact, 9 billion people living in Brooklyn, and we can ascertain that by counting, looking at the census, or just noting the impossibility of getting 9 billion people into the existing housing in Brooklyn.

Note: we distinguish subjective from objective claims to aid in argumentation and conversation.

Generally, we have to be very careful about giving subjective premises for an objective conclusion. “I feel like God exists” or “I feel like Sarmatians are sneaky people” are probably not good premises for the conclusions “God exists” or “Sarmatians are sneaky people.”

It’s also important to understand that, if someone makes an objective claim, we can’t respond with “that’s true for you but not for me.” Objective claims, by their nature, are not true relative to some person. An objective claim can be *false*, but it can’t be simply relative to a person’s beliefs—if it is, it’s not an objective claim. Further, just because a claim is *controversial* does not make it subjective! Most of the truly controversial claims are objective. We don’t develop a lot of controversy over claims like “I feel tired,” but there is a great deal of debate over claims like “There is only one God and He is the creator of the world.”

Finally, when someone makes a subjective claim but states it as though it were an objective claim, this can cause needless disagreement. If Tammy says “Beyonce is the best singer in the world,” she probably just means that Beyonce is her favorite singer. If Lamar responds with “no way, Taylor Swift is the best singer!” they could be on the verge of a pointless disagreement. There is no standard for “best singer in the world,” so there’s no settling this by argument. Instead, recognizing that Tammy was actually making a subjective claim, Lamar might ask, “really, what do you like about Beyonce’s singing?”

Probability, Certainty, and Monty Hall⁷

People often say they know things “for certain,” but they’re certainly wrong. Certainty has a connotation that means there is no doubt: you are absolutely, 100% positive that your claim is true. **Skepticism** is a theory that claims certainty and truth are impossibilities, and while we can have very good justified beliefs and claims backed by solid reasoning and evidence, nothing is ever certain. If you’re not a skeptic, then finding certainty is possible, but *very* hard. What do you think you would know for certain? In this class, the closest we will get to uncontroversial certainty certain logical deductions, like inferences and proofs. Proofs are aimed at telling us something for certain, while inferences are simply following something simple we know and figuring out what else it tells us. For example, if I say that “No bananas are underwear” (and we assume it’s true), then we also know that “No underwear are bananas.” Or if I say that “If you eat a banana, then you will sit on its peel, and you ate a banana...” what else could I say? That you’re sitting on its peel. If we assume that the first two claims (about eating bananas and sitting on peels) are true, then the conclusion must follow certainly. We’ll cover these concepts more later on the course, but for now, keep in mind that almost nothing is technically certain. If we’re not certain about things, then what can we say? Just that they’re more or less likely. And that’s where probability comes in to help us.

Probability is *how likely something is to happen*.

Many events can't be predicted with total certainty. The best we can say is how likely they are to happen, using the idea of probability.

Tossing a Coin

When a coin is tossed, there are two possible outcomes:

- heads (H) or
- tails (T)

We say that the probability of the coin landing H is $\frac{1}{2}$

And the probability of the coin landing T is $\frac{1}{2}$

Throwing Dice

When a single die is thrown, there are six possible outcomes: 1, 2, 3, 4, 5, 6.

The probability of any one of them is 1 in 6

In general:

Probability of an event happening = *Number of ways it can happen* divided by Total number of outcomes

Example: the chances of rolling a "4" with a die

Number of ways it can happen: 1 (there is only 1 face with a "4" on it)

Total number of outcomes: 6 (there are 6 faces altogether)

So the probability = 1 in 6

Example: there are 5 marbles in a bag: 4 are blue, and 1 is red. What is the probability that a blue marble gets picked?

Number of ways it can happen: 4 (there are 4 blues)

Total number of outcomes: 5 (there are 5 marbles in total)

So the probability = 4 in 5 = 0.8 (or 80%)

Probability is Just a Guide

Probability does not tell us exactly what will happen, it is just a guide

Example: toss a coin 100 times, how many Heads will come up?

Probability says that heads have a $\frac{1}{2}$ chance, so we can expect 50 Heads.

But when we actually try it we might get 48 heads, or 55 heads ... or anything really, but in most cases it will be a number near 50.

Words

Some words have special meaning in Probability:

Experiment or Trial: an action where the result is uncertain.

Tossing a coin, throwing dice, seeing what pizza people choose are all examples of experiments.

Example: choosing a card from a deck

There are 52 cards in a deck (not including Jokers)

So the Sample Space is all 52 possible cards: {Ace of Hearts, 2 of Hearts, etc... }

Sample Point: just one of the possible outcomes

Example: Deck of Cards

- the 5 of Clubs is a sample point
- the King of Hearts is a sample point

"King" is not a sample point. As there are 4 Kings that is 4 different sample points.

Event: a single result of an experiment

Example Events:

- Getting a Tail when tossing a coin is an event
- Rolling a "5" is an event.

An event can include one or more possible outcomes:

- Choosing a "King" from a deck of cards (any of the 4 Kings) is an event
- Rolling an "even number" (2, 4 or 6) is also an event

So:

- The Sample Space is all possible outcomes.
- A Sample Point is just one possible outcome.
- And an Event can be one or more of the possible outcomes.

Hey, let's use those words, so you get used to them:

Example: Alex wants to see how many times a "double" comes up when throwing 2 dice.

Each time Alex throws the 2 dice is an Experiment.

It is an Experiment because the result is uncertain.

The Event Alex is looking for is a "double", where both dice have the same number. It is made up of these 6 Sample Points:

{1,1} {2,2} {3,3} {4,4} {5,5} and {6,6}

The Sample Space is all possible outcomes (36 Sample Points):

{1,1} {1,2} {1,3} {1,4} ... {6,3} {6,4} {6,5} {6,6}

These are Alex's Results:

Experiment	Is it a Double?
{3,4}	No
{5,1}	No
{2,2}	Yes

Experiment	Is it a Double?
{6,3}	No
...	...

After 100 Experiments, Alex has 19 "double" Events ... is that close to what you would expect?

Monty Hall

While we think we have a good understanding of how chance and probability work, our instincts often mislead us. A prime example of problems we have in understanding and identifying probabilities and certainties is “The Monty Hall problem.”

The Monty Hall problem is a brain teaser, in the form of a probability puzzle, loosely based on the American television game show Let's Make a Deal and named after its original host, Monty Hall. The problem was originally posed (and solved) in a letter by Steve Selvin to the American Statistician in 1975. It became famous as a question from a reader's letter quoted in Marilyn vos Savant's "Ask Marilyn" column in Parade magazine in 1990:

Suppose you're on a game show, and you're given the choice of three doors: Behind one door is a car; behind the others, goats. You pick a door, say No. 1, and the host, who knows what's behind the doors, opens another door, say No. 3, which has a goat. He then says to you, "Do you want to pick door No. 2?" Is it to your advantage to switch your choice?

Is it to your advantage to switch? Does it matter? Think about what you would do and why. Try it out yourself in a little experiment where you use cards to represent the goats and car. Pretend to be the contestant and host by picking a door and then either switching or staying with your door. Try sticking with your pick the first 10 times and then switching the next 10 times (remember that Monty Hall will ALWAYS show you a goat when he reveals a door). Was there any difference in outcome? Why do you think you got these results? You can look online for further discussions of this “puzzle.”

This page titled [1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#) .

1.4: Distinction of Proof from Verification; Our Biases and the Forer Effect

Proof vs. Verification⁸

When you make observations, you gather evidence toward some new knowledge. Observations are just points of information that you can use as a building block with other bits to eventually arrive at new knowledge and understandings. But how exactly does information relate to our knowledge? It can do so in two ways: by proving something new or by verifying (or confirming) what we already know.

Verifying is the easier concept to understand and is also usually what we mean we use the word proof. For example, we say, Her breath smells like chocolate, so it proves what we already know: she ate the chocolate!

We're not proving anything. We're just verifying what we already knew and adding evidence to support the claim that we've already accepted. How did we accept this claim in the first place? We proved it.

Proof, therefore, works a little differently. When something is proven, we have learned something new. There is nothing to verify since we don't know what it is we're looking for. Proofs use observations and knowledge to get us to a new claim with the proper support that is required in order for us to accept the truth of the new claim we have uncovered. For example,

I set out a box of freshly imported Belgian chocolates on the table before heading to the restroom. When I returned, the box had been emptied. I wanted to find where it went. I suspected that Mary had eaten my chocolates, but I needed to *prove* it before I cast blame on her. A trail of chocolate was left on the floor so I followed it into the next room. In that room, sitting in a chair, I caught Mary brown-handed, eating chocolates, and I even saw the last one as it entered her mouth. I said, "A-ha! You ate my chocolates! The evidence *proves* it!" to which she did her best Shaggy impression (look it up if you don't get this), and said, "Wasn't me!" I leaned in to smell the distinctive smell of my precious brown gold that was recently pilfered. Her breath smelled like chocolate, so it *verified* what I already knew: she ate the chocolate.

The takeaway point is just this: with every bit of new information you receive, see how it fits into your beliefs and analysis and be sure you use it properly to either come to a new conclusion or support one you already have.

Facts, Values, and Biases

One thing to keep in mind is that everything we do is colored by our own views, beliefs, and experiences. We think that we know "facts" and that these are indisputable. It doesn't matter how we feel about them: facts are true, and objective evidence tells us this. While this is how we will behave on a daily basis, many philosophers a lot smarter than myself (notably W.V.O. Quine) have shown that this simply isn't true. Presumably, there is a distinction between what we think of as "facts" and "values". This is actually called the fact/value distinction, and it was generally assumed that there was a clear line between the two: something was either a fact or value. For example,

FACT: The sky is blue.

FACT: US Independence is celebrated on July 4.

FACT: Tuesday is after Monday.

VALUE: Coconut is disgusting.

VALUE: Blue is pleasing on the eyes.

VALUE: Kindness is a good trait.

In truth, facts and values are not distinct: in each there is at least a hint of the other. There will always be a value in a fact by the sheer "fact" that we call them "facts." Why is it that we *choose* to say it's a fact that "Tuesday is after Monday"? There must be something valuable about that statement that makes us want to identify it as a fact. "The sky is blue" is only a "fact" because we generally observe it to be a blue, an observation that is necessarily subjective since we all see colors differently. Finding the facts in values is much harder to do, and in all honesty, I have never understood the reasoning completely myself. The lessons from understanding that values are present in facts is what is important: recognize that no matter how *hard* the *truth* or *fact* is that you are claiming, your biases have influenced you to use them in ways you may never know.

The Forer Effect⁹

The **Barnum effect**, also called the **Forer effect**, is a common psychological phenomenon whereby individuals give high accuracy ratings to descriptions of their personality that supposedly are tailored specifically to them, that are in fact vague and general enough to apply to a wide range of people. This effect can provide a partial explanation for the widespread acceptance of some paranormal beliefs and practices, such as astrology, fortune telling, aura reading, and some types of personality tests.

These characterizations are often used by practitioners as a con-technique to convince victims that they are endowed with a paranormal gift. Because the assessment statements are so vague, people interpret their own meaning, thus the statement becomes "personal" to them. Also, individuals are more likely to accept negative assessments of themselves if they perceive the person presenting the assessment as a high-status professional.

The term "Barnum effect" was coined in 1956 by psychologist Paul Meehl in his essay *Wanted – A Good Cookbook*.

This page titled [1.4: Distinction of Proof from Verification; Our Biases and the Forer Effect](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#).

1.5: The Scientific Method

10

The procedure that scientists use is also a standard form of argument. Its conclusions only give you the likelihood or the probability that something is true (if your theory or hypothesis is confirmed), and not the certainty that it's true. But when it is done correctly, the conclusions it reaches are very well-grounded in experimental evidence. Here's a rough outline of how the procedure works.

- Observation: Something is observed in the world which invokes your curiosity.
- Theory: An idea is proposed which could explain why the thing which you observed happened, or why it is what it is. This is the part of the procedure where scientists can get quite creative and imaginative.
- Prediction: A test is planned which could prove or disprove the theory. As part of the plan, the scientist will offer a proposition in this form: "If my theory is true, then the experiment will have [whatever] result."
- Experiment: The test is performed, and the results are recorded.
- Successful Result: If the prediction you made came true, then the theory devised is strengthened, not proved or made certain. The theory is "verified." And then we go back and make more predictions and do more and more tests, to see if the theory can get stronger yet.
- Failed Result: If the prediction did not come true, then the theory is falsified, and there are strong reasons to believe the theory is false. Nothing is ever certain (the sun may not actually rise tomorrow, for example, even though we all know it will), but we will assume that we were wrong if observations do not match our theories. When our predictions fail, we go back and devise a new theory to put to the test, and a new prediction to go with it.

Actually, a failed experimental result is really a kind of success, because falsification tells us what doesn't work. And that frees up the scientist to pursue other, more promising theories. Scientists often test more than one theory at the same time, so that they can eventually arrive at the "last theory standing." In this way, scientists can use a form of disjunctive syllogism (a deductive argument form) to arrive at definitive conclusions about what theory is the best explanation for the observation. Here's how that part of the procedure works.

(P1) Either Theory 1 is true, or Theory 2 is true, or Theory 3 is true, or Theory 4 is true. (And so on, for however many theories are being tested.)

(P2) By experimental observation, Theories 1 and 2 and 3 were falsified.

(C) Therefore, Theory 4 is true.

Or, at least, Theory 4 is strengthened to the point where it would be quite absurd to believe anything else. After all, there might be other theories that we haven't thought of, or tested yet. But until we think of them, and test them, we're going to go with the best theory we've got.

There's a bit more to scientific method than this. There are paradigms and paradigm shifts, epistemic values, experimental controls and variables, and the various ways that scientists negotiate with each other as they interpret experimental results. There are also a few differences between the experimental methods used by physical scientists (such as chemists), and social scientists (such as anthropologists). Scientific method is the most powerful and successful form of knowing that has been employed. Every advance in engineering, medicine, and technology has been made possible by people applying science to their problems. It is adventurous, curious, rigorously logical, and inspirational – it is even possible to be artistic about scientific discoveries. And the best part about science is that anyone can do it. Science can look difficult because there's a lot of jargon involved, and a lot of math. But even the most complicated quantum physics and the most far-reaching astronomy follows the same method, in principle, as that primary school project in which you played with magnets or built a model volcano.

Doing the Scientific Method Yourself

We do the scientific method every day all the time when we learn or predict things. What will happen if you don't text/call/message your significant other for longer than you normally do? Test it and find out! What will happen if you put 5 packets of ketchup on a hot dog? Find out! Pick some variables, make a prediction of what will happen when you change the variables, and then observe the results when you make those changes. Were you correct? What have you learned? What experiment would you like to do to test your new understandings? Follow the method mentioned in this chapter and see what you can learn.

This page titled [1.5: The Scientific Method](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) ([NGE Far Press](#)) .

1.6: Diagramming Thoughts and Arguments - Analyzing News Media

Turning Your Thoughts into Arguments Visually

The start of any essay begins in one of two ways: a single idea you need to explore and expand upon or a hot mess of ideas that you need to organize. Well, they *should* begin in one of those two ways. You shouldn't already know your conclusion or thesis when you start because your research and analysis might take you to a different conclusion, and if you're already stuck on your answer, you will either miss seeing the truth or you will be guilty of being a bad, pig-headed, unreasonable person of ill-repute. Let the evidence and reason take you on a journey to the conclusion. Like my daughter says, "You never know what's going to happen until it happens."

So, how do you start to organize when preparing your thoughts on a topic? The short answer is: however you want. What I'm about to describe is a very messy way to organize, but it's a way that has worked well for both myself and countless others. I'm not even sure what to call it, and there are no formal rules. It's a type of brainstorming (where you just run with whatever ideas pop into your head) where you keep track. Here are the steps:

1. Write down the main point you want to start from, or the conclusion that you somehow hope to prove (don't accept as true yet, despite what your gut tells you), in the middle of a piece of paper. You can even circle it or box it in if you want.
2. Write down the first idea you have that relates to your main idea a few inches away from it in any direction. Draw a line connecting the two ideas, and if there is something important about *how* they connect, write that on the line.
3. Write down another idea somewhere else on the paper. Draw lines that connect it to any other ideas it relates to, using arrows to indicate if one idea leads to the other, and making notes on the connection (if relevant). If it relates to two ideas, that's fine. If it relates to the connection between ideas, that's fine, too.
4. Keep going, exploring more ideas in this same way.
5. ...keep going, doing the same thing.
6. If you get stuck for a little bit, think about an objection to something you've said. Write it down next to the idea that it counters, and give a response to it.
7. Do (6) again as many times as you feel like.
8. Tape on a new paper, since you're going to need more space now.

In no time, you'll have a whole set of ideas you're working with. This is the fun and quick part of the process. Organizing it and really making it make sense is the hard and tedious part. We'll cover that shortly, but now you need more practice on diagramming.

Breaking Apart the News: An exercise in diagramming

Pick any news article that actually has some bit of length. Pick one that is not merely a short presentation of events that occurred, but that is actually attempting (in some way) to argue something. Opinion articles always do this, so maybe just pick one of them. However the article is written, you can organize it in a visual form using the method just described by doing the following:

1. Write down the first claim, statement, belief, argument, thought, sentence, etc., that is made.
2. Write down the next one, and connect it to the first one (if it connects to it – if not, then just write it on another part of the paper for now, since it may or may not end up connecting to the starting point).
3. Write down the next one, and see how it might connect to the other claims already made.
4. Repeat. Keep going until you've gone through everything and see how they all connect and where they lead. If it's a well-written and argued piece, then everything will connect together and point to a final claim. If so, congratulations, you just read an article written by someone that has taken a philosophy class. If not (and I'd expect not), see how you might be able to fill in the blanks for them.

This page titled [1.6: Diagramming Thoughts and Arguments - Analyzing News Media](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

1.7: Creating a Philosophical Outline

6 Creating a Philosophical Outline¹²

Choosing a topic and figuring out the basics

When choosing your topic for a philosophical essay, make sure you choose a topic that requires you to take a position that requires significant defense. The basic things that you need to do for a complete outline is: pick your topic, describe it, pick your side, explain your side, defend it, and state and respond to an objection for your argument (such as, “Someone might disagree with me because I’m not a nuclear scientist, but they’re wrong because...”). For example, you cannot choose to argue that Double Stuf Oreos are better than regular Oreos because everyone would agree with that. You can, however, argue for one side in classic debates such as abortion, free will, or that the Dodgers are better than the Lakers.

You need to be sure to recognize the important philosophical aspects in your topic, break down the issues, and discuss them. You should first identify the important aspects of your issue – doing so will help you organize your thoughts and make your arguments. When you proofread your assignment (and you should do this) you should always think that the person grading it will be constantly asking “Why?” and you should be sure you have answers to these “Why?” questions. If you need more help, read your outline or essay aloud to a friend (seriously, despite how bad of an idea this sounds) – you’ll get some good feedback and notice problems for yourself.

Make sure you CONNECT all of your ideas to each other and always be sure that everything you say leads back to your thesis. If something you are saying doesn’t help you make your case, then you should probably leave it out.

One aspect of making a good argument is anticipating a strong objection to what you are saying and addressing it. Consider what an opponent to your view might say, make it as strong as you can, and then respond to it. You don’t have to completely destroy the argument, but you need to make a convincing case that your answer is better than your opponent’s answer. (TIP: If you don’t know where to begin, you can structure your essay by presenting the counterargument and using that to set up your own arguments, like “Some people say the death penalty is wrong because killing is always wrong. However, this is not a good argument and killing, especially in capital punishment, is permissible because...”)

While you will always be stating your opinions, you must be sure to back them up with arguments. An argument is NOT simply stating something – you must say WHY it supports what you say it does. It’s not about whether you are right or wrong, but whether your position is more justified than the others.

Outlines can take many forms, and I prefer to keep it simple. As long as the following get you’re your outline, you’ll have the skeleton of a properly structured essay:

- 1) Briefly describe what the topic you would like to write about.
- 2) Write your thesis statement.
- 3) Write a one paragraph introduction to your paper that (a) clearly states your thesis, (b) briefly states all of your reasons in support of your argument (as you will elaborate on in part 4), and (c) briefly states why someone who disagrees with you is wrong.
- 4) Write at least 3 reasons to support your thesis with at least 2 pieces of evidence or arguments that support each of your reasons.
- 5) State in ONE sentence what you think the strongest objection is to your thesis and then state in ONE sentence why you think the objection is wrong.
- 6) List at least 2 sources you will use to help make your argument – only ONE of them may be a dictionary or Wikipedia.
- 7) Write a one paragraph conclusion that brings your thesis and all of your points together.

Example of a thesis statement: “I agree with Socrates that Philosophers should rule us.” If you want to add more, then put your strongest and most important reason into it as well, such as by saying, “I agree with Socrates that Philosophers should rule us because they are so amazingly brilliant and kind.” These would be reasonable thesis statements in response to a question like, “Do you agree with Socrates that Philosophers should be rulers? Why or why not?” THEN you would go on to elaborate in good detail giving good reasons supporting your thesis statement.

See below for an example of how to do this.

Name: Noah Levin

1. Topic: There is a lot of disagreement over the effectiveness of online classes, especially in comparison to in-person classes. I would like to argue that they can be just as effective if they are run properly.

2. Thesis: Online courses can be just as effective as in-person courses when designed and taught properly.

3. Introduction:

A lot of people believe that online courses can never be as effective as in-person courses, but I disagree. I maintain that online courses can be just as effective as in-person courses when designed and taught properly. I believe this because all of the elements that are present in an in-person class can be maintained, and sometimes even enhanced, when done online. Many people have the misconception that discussion and interaction cannot take place in an online course, but with the proper use of things like discussion boards, blogs, wikis, and chat rooms, discussion and interaction can still take place effectively. In fact, because students have more time and are not “put on the spot” in online forums, discussing online can be more fruitful than it is in person. Additionally, with the plethora of media devices available to use, such as live webcasting and videos (both pre-recorded, like YouTube, and created by the instructor), there can be no loss in the effectiveness of instructional delivery, despite the fact that traditional lectures might not be present. Student engagement can also be had through the use of interactive media, like games and activities, which would be analogous to what could be done in an in-person class. When all is said and done, if an online course is run properly, it can be just as effective as an in-person class.

4. Reasons:

Reason 1: Discussions and interactions between students can take place online

Supporting evidence/argument #1: Discussion boards, etc., are good tools for discussing

Supporting evidence/argument #2: Students can think more about what they want to say before posting

Reason 2: Instructional delivery is not hindered from going online

Supporting evidence/argument #1: All of the materials that a student would use in a class, like textbooks, can still be used online

Supporting evidence/argument #2: Instructors can, at the very least, post videos of their own lectures online, which would make them no worse than in-person classes

Reason 3: Online games and activities can be useful in engaging students

Supporting evidence/argument #1: Playing a game online can help get students engaged and applying learning points

Supporting evidence/argument #2: For philosophy, there are a lot of interactive activities that have students directly apply critical thinking concepts, perhaps even better than could be done in an in-person class

5. Objection and response

Objection: Online classes cannot work as well because students don't get the personal interaction with an instructor as they do in in-person classes.

Response: Instructors can interact with students plenty with online courses through chat rooms, video chats, discussion boards, emails, and phone calls.

6. Sources:

7. Conclusion:

Although in-person courses have their perks and conform more with traditional educational methods, online courses can be just as effective when designed and taught properly. A properly designed online course will make use of available technologies and media to help engage students in creative and inspiring ways. They will also include plenty of discussions and interactions using web-based boards and blogs. The important thing to note, as numerous studies have illustrated (see the studies by Ithaka, 2012, and the US DOE, 2010), is that student learning is not hindered in online courses as compared to in-person courses. But this is not to say that any online course will be good – they need to be designed and taught properly so that the important educational elements that are present in traditional in-person classes are not lost and ideally end up enhanced. Also, who doesn't want to be able to attend class in their underwear at 3am?

Below is a blank template for you to use.

Name:

1. Topic: Summarize your topic here.
2. Thesis: Write your thesis clearly and simply here.
3. Introduction:

Write a one paragraph introduction that summarizes all of your points and reasons and DEFINITELY contains your thesis.

4. Reasons:

Reason 1: Write one of the main reasons you will use to support your thesis

Supporting evidence/argument #1: Write one thing to make me accept your reason (some sort of argument, evidence, statistic, etc.)

Supporting evidence/argument #2: Write another thing to make me accept your reason

Reason 2: Same as above

Supporting evidence/argument #1:

Supporting evidence/argument #2:

Reason 3: And same as above again

Supporting evidence/argument #1:

Supporting evidence/argument #2:

5. Objection and response

Objection: Write the strongest objection to your argument here.

Response: Write how you would respond to the objection.

6. Sources:

Source #1: ONLY ONE may be a dictionary or Wikipedia

Source #2:

7. Conclusion:

Write a one paragraph conclusion that contains a brief summary of your reasons and drives your point home.

This page titled [1.7: Creating a Philosophical Outline](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#).

CHAPTER OVERVIEW

2: Language - Meaning and Definition

The philosopher Ludwig Wittgenstein (1889-1951) was one of the most influential, and controversial, philosophers of the twentieth century. He spent most of his time thinking and writing about languages and how they work, with his theme focusing on the ways that language can create philosophical problems. He started off his career claiming that all philosophical problems are actually linguistic in nature, came up with a way of “proving” that all philosophical problems are actually linguistic ones (and if they’re not linguistic, then they are literally meaningless), left philosophy since there was nothing left to do in it, realized he was wrong, and spent the rest of his life trying to understand all the ways that there are genuine problems in philosophy that actually aren’t linguistic and offering ways that we might better understand them. Regardless of whether one agrees with Wittgenstein’s conclusions, rational people ought to concede he was right about one thing: many disagreements stem from linguistic problems. To resolve this, we simply (though it’s not actually simple) must use language clearly and precisely. If we eliminate all linguistic issues, then we’re left with the more meaningful philosophical problems, and *real* arguments can now happen since we know exactly what we’re talking about.

So how do we resolve these linguistic problems? By doing a few things:

- Appreciating the context in which we are talking, like the situation, audience, etc.
- Understanding the nature of the claims we are making (Are they generally accepted? Are they our own opinions?)
- Using simple and precise language (Instead of “There was that one day some time last week” you say “Last Wednesday” or instead of saying, “I don’t believe in religion” since I don’t know if that means you don’t believe religions exists, don’t believe in a particular religion, don’t believe God exists, etc., and instead say, “I don’t have a particular faith I practice because I don’t think any are correct.”)
- Clearly defining any ambiguous words you might use (like if you say, “I wish I were back at home” when you’re sitting in your living room, I might be wondering about your sanity, but if you say, “I wish I were back home in the town I grew up” then you’ve clarified what you mean by “home.”)

It’s easy, but tedious, to be clear in your speech and writing. If you practice it, however, it becomes second-nature and you will rarely be misunderstood or misinterpreted.

[2.1: Techniques of Defining- “Semantics” vs “Syntax” and Avoiding more Ambiguity](#)

[2.2: Criteria for Framing Definitions- It’s all about Context and Audience](#)

[2.3: Defining Terms Appropriately](#)

[2.4: Cognitive and Emotive Meaning - Abortion and Capital Punishment](#)

[2.5: Functions of Language and Precision in Speech](#)

[2.6: Defining Terms- Types and Purposes of Definitions](#)

This page titled [2: Language - Meaning and Definition](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by Noah Levin (NGE Far Press) .

2.1: Techniques of Defining- “Semantics” vs “Syntax” and Avoiding more Ambiguity

There are two big ways that statements can be ambiguous: they can use **improper semantics** or **improper syntax**. A semantic problem is one where you are running afoul of the meanings and word choices you have made or are using, and a syntactic problem is one where you are not phrasing or organizing your thoughts in a clear fashion. The goal with any writing is to make sure that your intended message is properly received. The best way to do this is to speak clearly, succinctly, and directly using the most precise words and grammar that you can.

You can run into semantic problems when you

- Don't use the correct words to express what you intend to communicate; or
- Use words with more than one meaning

English has many, many words that mean the same thing, and it is always fun to use the words that are the most poetic, but you should never sacrifice clarity for the sake of prose (when writing an argumentative paper). If you're writing poetry or fiction or almost anything except a critical paper, go ahead and go nuts with beautiful language and let the words flow from your fingertips and caress your pages like a fresh dewdrop falling on young grass at the dawn of a crisp spring morning. Otherwise, stick to the basics.

I think it's easiest to understand how to avoid semantic issues with examples. Look at the following sentences below and see how some sentences do a better job of communicating:

- Dallas cop fatally shoots neighbor in apartment after mistaking it for own

(It's unclear what the pronouns refer to)

- Dallas cop fatally shoots neighbor in his apartment after mistaking it for her own, police say

(This is better, but still not clear enough)

- A Dallas police officer fatally shot a man after she entered the wrong residence in her apartment building, thinking she was in her own home, authorities say.

(Longer, but quite clear)

“Fun to speak Yoda-like in riddles, is it not? Speak in whatever order you can! Versatile language is English, understand me you must.” While you still understand what I'm saying, it's much easier if I just say, “It can be fun to speak like Yoda, and you'll still understand me because that's how English works.” This is just one example of how syntax can impact the ways in which people understand you, and all this does is make people have to think a little harder about what you're saying in order to understand what you mean. There are more complex ways that syntax can go wrong and your meaning can actually be lost. The goal is to avoid any possible misperceptions in your language and meaning by doing the following

- Use a grammatical structure that allows for no confusion.
- Order your sentences so that they flow properly from one to another in the most natural fashion.
- Avoid using overly long or complex language and sentences.
- Write the most important points first and supporting ones later so that your reader has no problems following what you're saying. When making an argument, it's no problem to start by “spoiling” your conclusion.

Just like with semantic problems, I think it's easiest to understand how to avoid syntactic issues with examples. Look at the following sentences below and see how some do better jobs of communicating:

- Georgia mother charged in murders of 4 young children, their father smiles in court

(Who is doing the smiling? I think a comma was left out!)

- “Do you mind if I keep going?” Answer 1: Yes. Answer 2: No.

(The problem here is that with how the question is phrased, answering yes or no might mean the same thing – “yes, keep going” or “no, I don't mind”

One thing that helps to make things very clear is by examining and stating the relationship between concepts. Two very common relationships worth covering are necessity and sufficiency.

Necessary and Sufficient Conditions²³

In a conditional statement (“If...then...”), two conditions are given: a necessary and a sufficient condition.

Sufficient Conditions:

A is a sufficient condition for B whenever A is all that is needed to make B true, or whenever the occurrence of A is all that is needed for the occurrence of B.

If Fido is a dog, then Fido is a mammal.

“Fido is a dog” is all that’s needed to make it true that “Fido is a mammal.” So “Fido is a dog” is a sufficient condition for “Fido is a mammal.” Similarly, “Fluffy is a cat,” “Pokey is a rhinoceros,” “Trunky is an elephant,” and “Ollie is an ocelot” would be sufficient conditions to make each one of them mammals.

If it rains, the sidewalk will be wet.

If a dog pees on it, the sidewalk will be wet.

If someone spills soda on it, the sidewalk will be wet.

If someone sprays a hose on it, the sidewalk will be wet.

In each case, the antecedent (first term, after the “if”) expresses a sufficient condition for “the sidewalk will be wet.”

Necessary conditions: B is a *necessary* condition for A whenever A cannot occur without B also occurring, or whenever A cannot be true without B also being true. So, in all the cases above, the *consequent* (second term, after the “then”) is a necessary condition.

If Fido is a dog, then he is *necessarily* a mammal.

If I spray a hose on it, the sidewalk will *necessarily* get wet.

If John is older than Kevin, and Kevin is older than Lanai, then John is *necessarily* older than Lanai.

In each case, the word “necessarily” is not needed, because the conditional sentence already asserts the necessity.

For the following, fill in the blanks with “necessary” or “sufficient.”

1. Being a quarterback in the NFL is a _____ condition for being a football player.
2. Being a football player is a _____ condition for being an NFL quarterback.
3. Being able to fly a plane is a _____ condition for being an airplane pilot.
4. Spraying a hose on a dog is a _____ condition for making the dog's fur wet.
5. Being a guitarist is a _____ condition for being a musician.
6. Being a musician is a _____ condition for being a guitarist.
7. Firing an unsilenced gun is a _____ condition for making a loud noise.
8. Being famous is a _____ condition for being a movie star.
9. Being a movie star is a _____ condition for being famous.

Now, rewrite each of the above as a conditional sentence.

Because necessary conditions are distinct from sufficient conditions, the antecedent and consequent of a conditional statement cannot be reversed if you wish to maintain the truth and meaning of the sentence. In other words, saying:

Whenever a patient is feeling pain, the pre-occipital lobe of the brain is active.

is not the same as saying:

Whenever the pre-occipital lobe of the brain is active, the patient is feeling pain.

These cases should make that clear:

If that’s a dog, then it’s a mammal.

If that’s a mammal, then it’s a dog.

If you have five dollars, you have some money.

If you have some money, you have five dollars.

If you go outside in winter then you'll feel cold.

If you feel cold, then you've gone outside in the winter.

If you find a sentence where the meaning stays (essentially) the same when you've reversed antecedent and consequent, then you've found a case of what we call a **biconditional**. The biconditional is usually written as "if, and only if..." and both conditions are necessary and sufficient for each other. For example,

The existence of a child is a necessary and sufficient condition to know there is a parent.

There is a child if and only if there is a parent.

There is a parent if and only if there is a child.

This page titled [2.1: Techniques of Defining- "Semantics" vs "Syntax" and Avoiding more Ambiguity](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#) .

2.2: Criteria for Framing Definitions- It's all about Context and Audience

24

Before getting into any of the more analytic details of logical reasoning, let's consider the ways in which ideas 'play out' in the world, and the way we arrive at most of our beliefs. Most textbooks on modern logic assert that the basic unit of logic is the statement – a simple sentence which can be either true or false. But it seems to me that statements have to come from somewhere, and that they do not emerge from nothing. People do not come to believe things at random, or by magic. To my mind, the most obvious places where statements are born are one's intellectual environments, one's problems, and the questions that you and others in your environment tend to ask. Good thinking also begins in situations which prompt the mind to think differently about what it has taken for granted so far.

Intellectual Environments

Where does thinking happen? This may sound as if it's a bit of a silly question. Thinking, obviously, happens in your mind. But people do more than just think their own thoughts to themselves. People also share their thoughts with each other. Thoughts do not remain confined within your own brain: they also express themselves in your words and your actions. I'd like to go out on a bit of a limb here, and say that thinking happens not only in your mind, but also any place where two or more people gather to talk to one another and share their ideas with each other. In short, thinking happens wherever two or more people could have a dialogue with each other. In that dialogue, at least two people (but possibly many more) can express, share, trade, move around, examine, criticize, affirm, reject, modify, argue about, and generally communicate their own and each other's ideas. The importance of dialogue in reasoning is perhaps most important, and also most obvious, when we are reasoning about moral matters. The philosopher Charles Taylor (*Malaise of Modernity*, pg. 32) said:

Reasoning in moral matters is always reasoning with somebody. You have an interlocutor, and you start from where that person is, or with the actual difference between you; you don't reason from the ground up, as though you were talking to someone who recognized no moral demands whatever.

What Taylor says about moral reasoning also applies to other things we reason about. Whenever you have a conversation with someone about whether something is right, wrong, true, false, partially both, and so on, you do not start the conversation from nothing. Rather, you start from your own beliefs about such things, and the beliefs held by your partner in the conversation, and the extent to which your beliefs are the same, or different, as those of the other person. It is not by accident that Plato, one of the greatest philosophers in history, wrote his books in the form of dialogues between Socrates and his friends. Similarly, French philosopher Michel Foucault observed that especially among Roman writers, philosophy was undertaken as a social practice, often within institutional structures like schools, but also through informal relations like friendships and families. This social aspect of one's thinking was considered normal and even expected:

When, in the practice of the care of the self, one appealed to another person in whom one recognised an aptitude for guidance and counseling, one was exercising a right. And it was a duty that one was performing when one lavished one's assistance on another... (Foucault, *The Care of the Self*, pg. 53)

So, to answer the question 'Where does thinking happen?' we can say: 'any place where two or more people can have a conversation with each other about the things that matter to them'. And there are lots of such places. Where the Romans might have listed the philosophy schools and the political forums among those places, we today could add:

- Movies, television, pop music, and the entertainment industry
- Internet-based social networks like Facebook and YouTube
- Streets, parks, and public squares
- Pubs, bars, and concert venues
- Schools, colleges, and universities
- Mass media
- Religious communities and institutions
- The arts
- The sciences
- Courtrooms and legal offices
- Political settings, whether on a small or large scale

- The marketplace, whether local or global
- Your own home, with your family and friends
- Can you think of any more places like this?

In each of the places where thinking happens, there's a lot of activity. Questions are asked, answers are explored, ideas are described, teachings are presented, opinions are argued over, and so on. Some questions are treated as more relevant than others, and some answers meet with greater approval than others. It often happens that in the course of this huge and complicated exchange, some ideas become more influential and more prevalent than others. You find this in the way certain words, names, phrases or definitions get used more often. And you find it as certain ways to describe, define, criticize, praise, or judge things are used more often than others. The ideas that are expressed and traded around in these ways and in these places, and especially the more prevalent ideas, form the intellectual environment that we live in. Most of the time, your intellectual environment will roughly correspond to a social environment: that is, it will correspond (at least loosely) to a group of people, or a community that you happen to be part of. Think about all the groups and communities that you belong to, or have belonged to at one time or another:

- Families
- Sports teams
- The student body of your college
- The members of any social club you have joined
- The people at your workplace
- Your religious group (if you are religious)
- People who live in the same neighbourhood of your town or city
- People who speak the same language as you
- People who are roughly the same age as you
- People who come from the same cultural or ethnic background
- People who like the same music, movies or books as you
- People who play most of the same games as you
- Can you think of any more?

An intellectual environment will have a character of its own. That is, in one place or among one group of people, one idea or group of related ideas may be more prevalent than other ideas. In another place and among other people, a different set of ideas may dominate things. Furthermore, several groups may have very similar intellectual environments, or very different ones, or overlapping ones. Also note that you probably live in more than one social environment, and so you are probably hearing ideas from more than one intellectual environment too. An intellectual environment, with its prevalent ideas, surrounds everyone almost all the time, and it profoundly influences the way people think. It's where we learn most of our basic ideas about life and the world, starting at a very early age. It probably includes a handful of stock words and phrases that people can use to express themselves and be understood right away. This is not to say that people get all of their thoughts from their environment. Obviously, people can still do their own thinking wherever they are. And this is not to say that the contents of your intellectual environment will always be the same from one day to the next. The philosopher Alasdair MacIntyre observed that an intellectual tradition is often a continuity of conflict, and not just a continuity of thought. But this is to say that wherever you are, and whatever community you happen to be living in or moving through, the prevalent ideas that are expressed and shared by the people around you will influence your own thinking and your life in profound and often unexpected ways. By itself, this fact is not something to be troubled about. Indeed, in your early childhood it was probably very important for you to learn things from the people around you. For instance, it was better for a parent to tell you not to touch a hot barbecue with your bare hand, than for you to put your hand there yourself and find out what it feels like. But as you grow into adulthood, it becomes more and more important to know what one's intellectual environment is really like. It is very important to know what ideas are prevalent there, and to know the extent to which those ideas influence you. For if you know the character and content of the intellectual environment in which you live, you will be much better able to do your own thinking. You might end up agreeing with most, or even all of the prevalent ideas around you. But you will have agreed with them for your own reasons, and not (or not primarily) because they are the ideas of the people around you. And that will make an enormous difference in your life. Some intellectual environments are actually hostile to reason and rationality. Some people become angry, feel personally attacked, or will deliberately resist the questioning of certain ideas and beliefs. Indeed, some intellectual environments hold that intellectual thinking is bad for you! Critical reasoning sometimes takes great courage, especially when your thoughts go against the prevalent ideas of the time and place where you live.

World Views

Eventually, the ideas that you gathered from your intellectual environment, along with a few ideas of your own that you developed along the way come together in your mind. They form in your mind a kind of plan, a picture, or a model of what the world is like, and how it acts, and so on. This plan helps you to understand things, and also helps you make decisions. Philosophers sometimes call this plan a world view. Think for a moment about some of the biggest, deepest and most important questions in human life. These questions might include:

- What should I do with my life? Where should I go from here? Should I get married? What career should I pursue? Where is my place in the world? How do I find it? How do I create it?
- Is there a God? What is God like? Is there one god, or many gods? Or no gods at all? And if there is, how do I know? And if there's not, how do I know?
- Why are we here? Why are we born? Is there any point to it all?
- What is my society really like? Is it just or unjust? And what is Justice?
- Who am I? What kind of person do I want to be?
- What does it mean to be an individual? What does it mean to be a member of society?
- What happens to us when we die?
- What do I have to do to pass this course?
- Just what are the biggest, deepest and most important questions anyway?

These are philosophical questions. (Well, all but one of them.) Your usual way of thinking about these questions, and others like them is your world view. Obviously, most people do not think about these questions all of the time. We are normally dealing with more practical, immediate problems. What will I have for dinner tonight? If the traffic is bad, how late might I be? Is it time to buy a new computer? What's the best way to train a cat to use the litter-box? But every once in a while, a limit situation will appear, and it will prompt us to think about higher and deeper things. And then the way that we think about these higher and deeper things ends up influencing the way that we live, the way we make choices, the ways that we relate to other people, and the way we handle almost all of our problems. The sum of your answers to those higher and deeper questions is called your 'world view'. The word 'world view' was first coined by German philosopher Albert Schweitzer, in a book called "The Decay and Restoration of Civilization", first published in 1923. Actually, the word that Schweitzer coined here is the German word *Weltanschauung*. There are several possible ways to translate this word. In the text quoted above, as you can see, it's translated as "theory of the universe". It could also be translated as "theory of things" or "world conception". Most English speakers use the simpler and more elegant sounding phrase "world view". Here's how Schweitzer himself defined it:

The greatest of the spirit's tasks is to produce a theory of the universe. What is meant by a theory of the universe? It is the content of the thoughts of society and the individuals which compose it about the nature and object of the world in which they live, and the position and the destiny of mankind and of individual men within it. What significance has the society in which I live and I myself in the world? What do we want to do in the world? What do we hope to get from it? What is our duty to it? The answer given by the majority to these fundamental questions about existence decides what the spirit is in which they and their age live. (Schweitzer, *The Decay and Restoration of Civilization*, pg. 80-1)

Schweitzer's idea here is that a world-view is more than a group of beliefs about the nature of the world. It is also a bridge between those scientific or metaphysical beliefs, and the ethical beliefs about what people can and should do in the world. It is the intellectual narrative in terms of which the actions, choices, and purposes of individuals and groups make sense. It therefore has indispensable practical utility: it is the justification for a way of life, for individuals and for whole societies. In this sense, a world view is not just something you 'have'; it is also something that you 'live with'. And we cannot live without one. "For individuals as for the community," Schweitzer said, "life without a theory of things is a pathological disturbance of the higher capacity for self-direction." (Schweitzer, *ibid*, pg. 86) Let's define a world view as follows: A world view is the sum of a set of related answers to the most important questions in life. Your own world view, whatever it is, will be the sum of your own answers to your philosophical questions, whatever you take those questions to be, and whether you have thought about them consciously or not. Thus your world view is intimately tied to your sense of who you are, how you want to live, how you see your place in your world and the things that are important to you. Not only your answers to the big questions, but also your choice of which questions you take to be the big questions, will form part of your world view. And by the way, that's a big part of why people don't like hearing criticism. A judgment of a world view is often taken to be a judgment of one's self and identity. But it doesn't have to be that way. Some world views are so widely accepted by many people, perhaps millions of people, and are so historically influential, perhaps over thousands of years, that they have been given names. Here are a few examples:

- **Modernism:** referring to the values associated with contemporary western civilization, including democracy, capitalism, industrial production, scientific reasoning, human rights, individualism, etc.
- **Heliocentrism:** the idea that the sun is at the center of our solar system, and that all the planets (and hundreds of asteroids, comets, minor planets, etc.) orbit around the sun.
- **Democracy:** the idea that the legitimacy of the government comes from the will of the people, as expressed in free and fair elections, parliamentary debate, etc.
- **Christianity:** The idea that God exists; that humankind incurred an ‘original sin’ due to the events in the Garden of Eden, and that God became Man in the person of Jesus to redeem humanity of its original sin.
- **Islam:** The idea that God exists, and that Mohammed was the last of God’s prophets, and that we attain blessedness when we live by the five pillars of submission: daily prayer, charity, fasting during Ramadan, pilgrimage to Mecca, and personal struggle.
- **Marxism:** The idea that all political and economic corruption stems from the private ownership of the means of production, and that a more fair and just society is one in which working class people collectively own the means of production.
- **Deep Ecology:** The idea that there is an important metaphysical correlation between the self and the earth, or that the earth forms a kind of expanded or extended self; and that therefore protecting the environment is as much an ethical requirement as is protecting oneself.
- **The Age of Aquarius/The New Age:** The idea that an era of peace, prosperity, spiritual enlightenment, and complete happiness is about to dawn upon humankind. The signs of this coming era of peace can be found in astrology, psychic visions, Tarot cards, spirit communications, and so on.

And some of these world views may have other, sub-views bundled inside them. For instance:

- Democracy
 - a. Liberalism
 - b. Conservatism
 - c. Democratic Socialism
- Buddhism
 - a. Mahayana
 - b. Theravada
 - c. Tibetan Bon-Po
 - d. Zen

Clearly, not all world views are the same. Some have different beliefs, different assumptions, different explanations for things, and different plans for how people should live. Not only do they produce different answers to these great questions, but they often start out with different great questions. Some are so radically different from each other that the people who subscribe to different world views might find it very difficult to understand each other. In summary, your world view and the intellectual environment in which you live, when taken together, form the basic background of your thinking. They are the source of most of our ideas about nearly everything. If you are like most people, your world view and your intellectual environment overlap each other: they both support most of the same ideas. Sometimes there will be slight differences between them; sometimes you may find differences so large that you may feel that one of them must be seriously wrong, in whole or in part. Differing world views and differing intellectual environments often lead to social and personal conflict. It can be very important, therefore, to consciously and deliberately know what your own world view really is, and to know how to peacefully sort out the problems that may arise when you encounter people who have different world views.

This page titled [2.2: Criteria for Framing Definitions- It’s all about Context and Audience](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#) .

2.3: Defining Terms Appropriately

Now it is your turn to go about clarifying all the terms that you use in your work. For something you are writing, you are to go through your main arguments first (and every other part, if you have the time) very slowly and cautiously examining every keyword you use and ask yourself the following:

- What do I want to say here?
- Is this sentence saying what I want it to?
- Are these words expressing what I want them to?
- Are there better words to use? (ie, more precise vocabulary)
- Are there any structural problems getting in the way? Do your thoughts and sentences flow into each other and appear in the right order?
- If you have to use ambiguous words, have you defined them using an appropriate technique?
- Is the vocabulary you have chosen appropriate for your purposes? Do you need to use different vocabulary or methods of speech?

Very seriously considering each of these questions at every step in your writing will keep you quite busy.

This page titled [2.3: Defining Terms Appropriately](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) ([NGE Far Press](#)) .

2.4: Cognitive and Emotive Meaning - Abortion and Capital Punishment

Types of Meanings¹⁴

Cognitive meaning is when words are used to convey information and emotive meaning is when words are used to convey your own beliefs (your emotions). These relate back to the discussion of subjective and objective claims back in Chapter 2, but they are not the same thing. For example, you might want to say,

Coconut is disgusting.

This is a claim phrased as an **objective claim** (it's declarative and is subject to being true or false) and has cognitive meaning since it is communicating information. When someone says this, what they actually mean is something like this,

I believe that coconut is disgusting.

This claim is now phrased as a **subjective claim** with emotive meaning since the truth value of it is based upon the reality of whether or not I actually believe this and it is conveying my own feelings on the topic. Additionally, it is cognitive because it is conveying information. Every single emotive statement will also be cognitive because anything that is said conveys at least a minimal amount of information. The issue then is when something also (or only) conveys emotive meaning.

Why does this matter? Because if we're using a lot of emotive meaning, we might be muddling up the facts and the importance of what we're trying to say. For example, if I say, "those people are mean jerks," I might not be as convincing as if I say, "those people were just bullying that person in a wheelchair, which is not a nice thing to do." The hope is that we avoid emotive meaning as much as we can, but it's unavoidable in any argument: by taking a side and defending it, you will be using your own beliefs and emotions. That's just fine, but your goal should be to be as impartial and fair in your claims as you can be, remembering to defend each and every belief you have as much as is necessary to convince your reader that your viewpoint is justified.

Framing Language¹⁵

One of the ways that your intellectual environment and your world view expresses itself is in the use of framing language. These are the words, phrases, metaphors, symbols, definitions, grammatical structures, questions, and so on which we use to think and speak of things in a certain way. We frame things by describing or defining them with certain interpretations in mind. We also frame things by the way we place emphasis on certain words and not on others. And we frame things by interpreting and responding selectively to things said by others. As an example, think of some of the ways that people speak about their friendships and relationships. We say things like "We connected", "Let's hook up", "They're attached to each other", and "They separated". We sometimes speak of getting married as "getting hitched". These phrases borrow from the vocabulary of machine functions. And to use them is to place human relations within the frame of machine functions. Now this might be a very useful way to talk about relationships, and if so, then it is not so bad. But if for some reason you need to think or speak of a relationship differently, then you may need to invent a new framing language with which to talk about it. And if this is the only framing language you've ever used to talk about relationships, it might be extremely difficult for you to think about relationships any other way. As a thought experiment, see if you can invent a framing language for your friendships and relationships based on something else. Try using a framing language based on cooking, or travel, or music, or house building, as examples. Here's another example of the use of framing language. Consider the following two statements:

"In the year 1605, Guy Fawkes attempted to start a people's revolution against corruption, inherited privilege, and social injustice in the British government."

"In the year 1605, Guy Fawkes planned a terrorist attack against a group of Protestant politicians, in an attempt to install a Catholic theocracy in Britain."

Both of these statements, taken as statements of fact, are true. But they are both framed very differently. In the first statement, Fawkes is portrayed as a courageous political activist. In the second, he is framed (!) as a dangerous religious fanatic. And because of the different frames, they lead the reader to understand and interpret the man's life and purposes very differently. This, in turn, leads the reader to draw different conclusions. In other situations, the use of framing language can have serious economic or political consequences. Consider, as an example, the national debate that took place in the United States over the Affordable Health Care Act of 2009. The very name of the legislation itself framed the discussion in the realm of market economics: the word 'affordable' already suggests that the issue has to do with money. And most people who participated in that national debate, including supporters and opponents and everything in between, spoke of health care as if it is a kind of market commodity, which

can be bought or sold for a price. The debate thus became primarily a matter of questions like who will pay for it (the state? individuals? insurance companies?), and whether the price is fair. But there are other ways to talk about health care besides the language of economics. Some people frame health care as a human right. Some frame it as a form of organized human compassion, and some as a religious duty. But once the debate had been framed in the language of market economics, these other ways of thinking about health care were mostly excluded from the debate itself. As noted earlier, it's probably not possible to speak about anything without framing it one way or another. But your use of framing language can limit or restrict the way things can be thought of and spoken about. They can even prevent certain ways of thinking and speaking. And when two or more people conversing with each other frame their topic differently, some unnecessary conflict can result, just as if they were starting from different premises or presupposing different world views. So it can be important to monitor one's own words, and know what frame you are using, and whether that frame is assisting or limiting your ability to think and speak critically about a particular issue. It can also be important to listen carefully to the framing language used by others, especially if a difference between their framing language and yours is creating problems. And speaking of problems: this leads us to the point where the process of critical thinking begins.

Problems

Usually, logic and critical thinking skills are invoked in response to a need. And often, this need takes the form of a problem which can't be solved until you gather some kind of information. Sometimes the problem is practical: that is, it has to do with a specific situation in your everyday world.

For example:

- Perhaps you have an unusual illness and you want to recover as soon as possible.
- Perhaps you are an engineer and your client wants you to build something you've never built before.
- Perhaps you just want to keep cool on a very hot day and your house doesn't have an air conditioner.

The problem could also be theoretical: in that case, it has to do with a more general issue which impacts your whole life altogether, but perhaps not any single separate part of it in particular. Religious and philosophical questions tend to be theoretical in this sense. For example:

- You might have a decision to make which will change the direction of your life irreversibly.
- You might want to make up your mind about whether God exists.
- You might be mourning the death of a beloved friend.
- You might be contemplating whether there is special meaning in a recent unusual dream.
- You might be a parent and you are considering the best way to raise your children.

The philosopher Karl Jaspers described a special kind of problem, which he thought was the origin of philosophical thinking. He called this kind of problem a **Grenzsituationen**, or a "limit situation".

Limit situations are moments, usually accompanied by experiences of dread, guilt or acute anxiety, in which the human mind confronts the restrictions and pathological narrowness of its existing forms, and allows itself to abandon the securities of its limitedness, and so to enter new realm of self-consciousness. (Stanford encyclopaedia of philosophy, online edition, entry on Karl Jaspers.)

In other words, a limit situation is a situation in which you meet something in the world that is unexpected and surprising. It is a situation that more or less forces you to acknowledge that your way of thinking about the world so far has been very limited, and that you have to find new ways to think about things in order to solve your problems and move forward with your life. This acknowledgement, according to Jaspers, produces anxiety and dread. But it also opens the way to new and (hopefully!) better ways of thinking about things. In general, a limit situation appears when something happens to you in your life that you have never experienced before, or which you have experienced very rarely. It might be a situation in which a longstanding belief you have held up until now suddenly shows itself to have no supporting evidence, or that the consequences of acting upon it turn out very differently than expected. You may encounter a person from a faraway culture whose beliefs are very different from yours, but whom you must regularly work with at your job, or around your neighbourhood. You may experience a crisis event in which you are at risk of death. A limit situation doesn't have to be the sort of experience that provokes a nervous breakdown or a crisis of faith, nor does it have to be a matter of life and death. But it does tend to be the type of situation in which your usual and regular habits of thinking just can't help you. It can also be a situation in which you have to make a decision of some kind, which doesn't necessarily require you to change your beliefs, but which you know will change your life in a non-trivial way.

Observation

Thus far, we have noted the kinds of problems that tend to get thinking started, and the background in which thinking takes place. Now we can get on to studying thinking itself. In the general introduction, I wrote that clear critical thinking involves a process. The first stage of that process is observation. When observing your problem, and the situation in which it appears, try to be as objective as possible. Being objective, here, means being without influence from personal feelings, interests, biases, or expectations, as much as possible. It means observing the situation as an uninvolved and disinterested third-person observer would see it. (By ‘disinterested’ here, I mean a person who is curious about the situation but who has no personal stake in what is happening; someone who is neither benefitted nor harmed as the situation develops.) Although it might be impossible to be totally, completely, and absolutely objective, still it certainly is possible to be objective enough to understand a situation as clearly and as completely as needed in order to make a good decision. When you are having a debate with someone it is often very easy, and tempting, to simply accuse your opponent of being biased, and therefore in no position to understand something properly or make decisions. If someone is truly biased about a certain topic, it is rational to doubt what someone says about that topic. But having grounds for reasonable doubt is not the same as having evidence that a proposition is false. Moreover, having an opinion, or a critical judgment about something, or a world view, is not the same as having a bias. Let us define a bias here as the holding of a belief or a judgment about something even after evidence of the weakness or the faultiness of that judgment has been presented. We will see more about this when we discuss Value Programs. For now, just consider the various ways in which we can eliminate bias from one’s observations as much as possible. Here are a few examples:

- Take stock of how clearly you can see or hear what is going on. Is something obstructing your vision? Is it too bright, or too dark? Are there other noises nearby which make it hard for you to hear what someone is saying?
- Describe your situation in words, and as much as possible use value-neutral words in your description. Make no statement in your description about whether what is happening is good or bad, for you or for anyone else. Simply state as clearly as possible what is happening. If you cannot put your situation into words, then you will almost certainly have a much harder time understanding it objectively, and reasoning about it.
- Describe, also, how your situation makes you feel. Is the circumstance making you feel angry, sad, elated, fearful, disgusted, indignant, or worried? Has someone said something that challenges your world view? Your own emotional responses to the situation are part of what is ‘happening’. And these too can be described in words so that we can reason about them later.
- Also, observe your instincts and intuitions. Are you feeling a ‘pull’, so to speak, to do something or not do something in response to the situation? Are you already calculating or predicting what is likely to happen next? Put these into words as well.
- Using numbers can often help make the judgment more objective. Take note of anything in the situation that can be counted, or measured mathematically: times, dates, distances, heights, shapes, angles, sizes, monetary values, computer bytes (kilobytes, megabytes, etc.), and so on.
- Take note of where your attention seems to be going. Is anything striking you as especially interesting or unusual or unexpected?
- If your problem is related to some practical purpose, take note of everything you need to know in order to fulfill that purpose. For instance, if your purpose is to operate some heavy machinery, and your problem is that you’ve never used that machine before, take note of the condition of the safety equipment, and the signs of wear and tear on the machine itself, and who will be acting as your “spotter”, and so on.
- If other people are also observing the situation with you, consult with them. Share your description of the situation with them, and ask them to share their description with you. Find out if you can see what they are seeing, and show them what you are seeing. Also, try to look for the things that they might be missing.

Separating your observations from your judgments and opinions can often be difficult. But the more serious the problem, the more important it can be to observe something non-judgmentally, before coming to a decision. With that in mind, here’s a short exercise: which of the following are observations, and which are judgments? Or, are some of them a bit of both?

- That city bus has too many people on it.
- The letter was delivered to my door by the postman at 10:30 am.
- The two of them were standing so close to each other that they must be lovers.
- The clothes she wore suggested she probably came from a very rich family.
- The kitchen counter looked like it had been recently cleaned.
- He was swearing like a sailor.
- The old television was too heavy for him to carry.
- There’s too much noise coming from your room, and it’s driving me crazy!

- The latest James Bond film was a lot of fun.
- The latest James Bond film earned more than \$80 million in its first week.
- I hate computers!
- The guy who delivered the pizza pissed me off because he was late.

Two case studies: Abortion and Capital Punishment¹⁶

We can apply all of these uses of language in two controversial topics: abortion and capital punishment. These two topics are full of claims and meanings of all kinds. Things to look at are:

- What type of language is used?
- How are terms defined?
- Which statements are more emotive and more cognitive?
- Which claims are subjective and which are objective?

There will be a lot more to keep in mind, but the next time you see an argument about one of these, consider all these things when you weigh the strength of the argument. I have four brief arguments below (one on each side of each of these arguments), so assess these for flaws because of the ways the “facts” and beliefs are being presented.

Argument One:

“Abortion is wrong because it’s murder. You are killing a tiny human being, and that’s just bad. It’s disgusting how they cut up the little person and suck them out of the womb. It’s evil because the bible says so, too.”

Argument Two:

“Abortion needs to be an option for every woman to have. It’s her body and she can do with it whatever she wants. I would hate it if someone told me what to do with my own body, so no one has the right to say people can’t get abortions.”

Argument Three:

“Capital punishment is wrong because it makes us as bad as the murderer. Just because they killed someone doesn’t mean we have to stoop to their level. It’s also cruel and no one should have to be murdered in the ways that they are, especially by the government. We should be ashamed of the practice.”

Argument Four:

“Capital punishment is the only fair punishment for murder. If someone kills another person, then they need to be killed, too. If you owe someone money, we make you pay it back. If I were murdered, I would want that person to die, too. Anything else is too lenient.”

This page titled [2.4: Cognitive and Emotive Meaning - Abortion and Capital Punishment](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#).

2.5: Functions of Language and Precision in Speech

Good Linguistic Habits¹⁷

Simplicity

Sometimes you may find that things are more complex or more elaborate than they appear to be at first. And it is often the job of reason to uncover layers of complexity behind appearances. Still, if you have two or more explanations for something, all of which are about as good as each other, the explanation you should prefer is the simplest one. This principle of simplicity in good reasoning is sometimes called Ockham's Razor. It was first articulated by a Franciscan monk named Brother William of Ockham, who lived from 1288 to 1348. His actual words were "Entia non sunt multiplicanda sine necessitate."¹⁸ In English, this means 'No unnecessary repetition of identicals'. This is a fancy way of saying, 'Well it's possible that there are twenty-three absolutely identical tables occupying exactly the same position in space and time, but it's much simpler to believe that there's just one table here. So let's go with the simpler explanation.' Ockham's original point was theological: he wanted to explain why monotheism is better than polytheism. It's simpler to assume there's one infinite God, than it is to assume there are a dozen or more. Ockham's idea has also been applied to numerous other matters, from devising scientific theories to interpreting poetry, film, and literature. Other ways to express this idea go like this: "All other things being equal, the simplest explanation tends to be the truth", and "The best explanation is the one which makes the fewest assumptions."

Precision

There are a lot of words in every language that have more than one meaning. This is a good thing: it allows us more flexibility of expression; it is part of what makes poetry possible; and so on. But for the purpose of reasoning as clearly and as systematically as possible, it is important to use our words very carefully. This usually means avoiding metaphors, symbols, rhetorical questions, weasel words, euphemisms, tangents, equivocations, and 'double speak'. When building a case for why something is true, or something else is not true, and so on, it is important to say exactly what one means, and to eliminate ambiguities as much as possible. The simplest way to do this is to craft good definitions. A definition can be imprecise in several ways; here are some of them.

- Too broad: it covers more things than it should.

Example of a broad definition: "All dogs are four-legged animals." (Does that mean that all four-legged animals are dogs?)

- Too narrow: it covers too few things.

Example of a narrow definition: "All tables are furniture pieces placed in the dining rooms of houses and used for serving meals." (Does that mean that tables in other rooms used for other purposes are not 'true' tables?)

- Circular: the word being defined, or one of its closest synonyms, appears in the definition itself.

Example of a Circular definition: "Beauty is that which a given individual finds beautiful." (This actually tells us nothing about what beauty is.)

- Too vague: The definition doesn't really say much at all about what is being defined, even though it looks like it does.

Example of a vague definition: "Yellowism is not art or anti-art. Examples of Yellowism can look like works of art but are not works of art. We believe that the context for works of art is already art."¹⁹ (And I don't know what this means at all.)

Patience

Good philosophical thinking takes time. Progress in good critical thinking is often very slow. The process of critical thinking can't be called successful if it efficiently maximizes its inputs and outputs in the shortest measure of time: we do not produce thoughts in the mind like widgets in a factory. The reason for this is because good critical thinking often needs to uncover that which subtle, hard to discern at first, and easy to overlook. I define subtlety as 'a small difference or a delicate detail which takes on greater importance the more it is contemplated.' As a demonstration, think of how many ways you can utter the word 'Yes', and mean something different every time. This also underlines the importance of precision, as a good thinking habit. As another example: think of how the colour planes in a painting by Piet Mondrian, such as his 'Composition with Yellow, Blue, and Red' have squares of white framed by black lines, but none of the white squares are exactly the same shade of white. You won't notice this if you look at the painting for only a few seconds, or if you view a photo of the painting on your computer screen, and your monitor's

resolution isn't precise enough to render the subtle differences. But it is the job of reason to uncover those subtleties and lay them out to be examined directly. And the search for those subtleties cannot be rushed.

Consistency

When we looked at what a world view is, we defined it as 'the sum of a set of related answers to the most important questions in life'. It's important that one's world view be consistent: that your answers to the big questions generally cohere well together, and do not obviously contradict each other. Inconsistent thinking usually leads to mistakes, and can produce the uncomfortable feeling of cognitive dissonance. And it can be embarrassing, too. If you are more consistent, you might still make mistakes in your thinking. But it will be a lot easier for you to identify those mistakes, and fix them. Consistency also means staying on topic, sticking to the facts, and following an argument to its conclusion. Obviously it can be fun to explore ideas in a random, wandering fashion. But as one's problems grow more serious, it becomes more important to stay the course. Moreover, digressing too far from the topic can also lead you to commit logical fallacies such as Straw Man (creating an easy-to-defeat argument that no one actually believes) and Red Herring (deliberately diverting people away from the topic at hand).

Imprecision: Vagueness and Ambiguity²⁰

Vagueness: You know, that one thing that someone did once .

Vincinal the midden, you keck – right? Yeah, of course! You do agree with me, don't you?

So do you know what that means? If you don't, but you agreed with me anyway, then fell victim to obfuscation. Obfuscation is intentionally making something confusion, often with the intention of confusing the listener. In that case, I was saying something and trying to pressure you into agreeing with me. Perhaps a doctor uses medical jargon so that she doesn't have to explain what is actually going – and that you won't ask. Don't obfuscate. It violates my primary class rule. By the way, "Vincinal the midden, you keck" means "Near the garbage heap, you vomit." Yes, it's English.

Obfuscation is just one example of unclarity. Unclarity is often the sign of unclear thoughts, so we're going to our best to avoid being unclear for this reason. There are many types of unclarity out there, so we'll examine them in the hope that you avoid them.

Vague terms are mostly imprecise. Like if I say, "I have a lot of M&Ms", it doesn't really tell you how many. Or if I say, "I'll fix the car next month," you don't really have a good idea of

when that will happen. Many vagueness problems can be resolved by simply defining the vague terms more precisely, or avoiding them altogether.

There is an interesting fallacy-related paradox called a "sorites paradox" or "paradox of the heap". Here is an example of one:

1. Someone with 1 finger does not have a lot of fingers.
2. If someone with 1 finger does not have a lot of fingers, someone with 2 fingers does not have a lot of fingers.
3. Therefore, someone with 2 fingers does not have a lot of fingers.
4. If someone with 2 fingers does not have a lot of fingers, then someone with 3 fingers does not have a lot of fingers.
5. Therefore, someone with 3 fingers does not have a lot of fingers.

...Therefore someone with 1,000,000,000 fingers does not have a lot of fingers

What are the problems with this line of reasoning? Well, it's definitely unsound, because someone with 1 billion fingers certainly has a lot of them. It's a paradox because there's a clear contradiction in what we believe and no clear way out of it: the logic seems to make sense, but the conclusion is clearly wrong. So how do we resolve this paradox? Probably say that anything more than 11 fingers is a lot and leave it at that. However, what if we did this argument instead?

1. 1,000,000 grains of sand is a heap.
2. If 1,000,000 grains of sand is a heap, then 999,999 grains of sand is a heap.
3. Therefore, 999,999 grains of sand is a heap.

...Therefore 1 grain of sand is a heap.

How do we get out of this one? Maybe say you know a heap when you see it? There is no clear resolution to the difficulties here (but you can read more at Wikipedia if you want: http://en.Wikipedia.org/wiki/Sorites_paradox), so you just need to be aware of issues like this. I bring up sorites paradoxes because there is an important set of fallacies related to them. These are known as slippery slopes. Fallacies are when one uses a particular method of reasoning that generally goes wrong. The methods employed by most fallacies are just ways of reasoning or making arguments, and they are not necessarily automatically wrong (well, some

formal fallacies can't be correct) but many informal fallacies use a line of reasoning that might actually be correct. Oftentimes, these lines of reasoning are incorrect when you encounter them. Slippery slopes are a prime example of a fallacy that people use and generally result in faulty conclusions, but may sometimes actually result in a strong argument if it's done carefully in the right contexts.

Slippery Slopes

The following is an example of a slippery slope:

Because we cannot draw a clear line between when someone is bald and is not bald, we cannot say that anyone is bald.

You can see how this is similar to a sorites paradox and goes a little further by claiming because we can't distinguish between traits when something changes gradually, we can't distinguish at all.

All slippery slopes have this general format: *A* makes sense, but *A* leads to *B*, and *B* is clearly wrong, so we should reject *A*. In the case of baldness, you are not bald if you have 120,000 hairs and if you are not bald if you have 120,000 hairs, then you are not bald if you have 119,999. Makes sense, right? But if this is true, then (via a sorites) if you have 1 hair, you are not bald. So, we should reject the idea that you are not bald if you have 5,000 hairs – which means if you have a full head of hair, you are bald.

In a slippery slope, you are worried about gradually sliding into a problem. These examples we have seen are examples of conceptual slippery slopes, which have 2 general assumptions:

- 1) We should not draw a distinction between things that are not significantly different
- 2) If *A* is not significantly different than *B* and *B* is not significantly different than *C*, then *A* is not significantly different than *C*

The real question to ask is this:

When do small differences make big differences?

Slippery slopes are common in ethics, and depending upon how you view things, they can be either a good argument or a terrible one. One kind can be called a "fairness slippery slopes" and awarding grades gives an excellent example:

If a person with 90% deserves an A, then it's only fair to give someone with 89% an A since there is no significant difference between their percentage in the class....If a person with 50% deserves an A, then a person with 49% deserves an A...

There are also causal slippery slope arguments, like:

Although assisted suicide (allowing someone, such as a doctor, to help someone else commit suicide) in certain cases is OK, we shouldn't allow it because it will lead to euthanasia (a person humanely ending the life of another person that is suffering and requests it), and that's not OK.

This can be a good argument if you think euthanasia really is a problem AND allowing assisted suicide will really lead to it. It is a fallacy if you incorrectly believe, or do not have reasons to support, the idea that assisted suicide WILL lead to euthanasia. There are many other examples of causal slippery slopes in which someone doesn't want to allow one thing they might like because they're worried it will lead to something they don't: gay marriage (the worry that it might lead to polygamy), military involvement (if we get into Syria, we will have to get into Iran), raises (If I give you a raise, I'll have to give everyone else a raise), etc. They have a specific format:

A is probably acceptable, but *A* leads to be *B* and *B* is not acceptable, so we shouldn't allow *A*

The important questions to ask are:

Is the result really bad? Is the result really very likely? Does this bad result outweigh the benefits of the proposal?

Ambiguity

College students make tasty snacks! Think about if this is said at a college bake sale or if it is said by a giant in the afternoon after playing a long game of squash the college dorms. The

sentence is ambiguous because you don't know exactly what I mean since it can be understood in different ways. There are two kinds of ambiguity:

Semantic ambiguity: ambiguous words

"I like football" (which football?)

“Let’s all go to the shower” (the wedding shower, pervert)

Syntactic ambiguity: amphiboly, or vague grammar

“How to get money out of politics” (people don’t spend money on it or how you can get money out of being a politician?)

“The conquest of the Persians” (were they conquering or being conquered?)

We can clarify an ambiguous statement by giving more information:

Mary had a little lamb...

It followed her to school

Or

And then some broccoli

The primary ways of fixing the problems of ambiguity are:

- 1) Distinguish ambiguous things
- 2) Restate things clearly
- 3) Reevaluate what is being said (in case you are actually wrong)

This page titled [2.5: Functions of Language and Precision in Speech](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

2.6: Defining Terms- Types and Purposes of Definitions

9 Defining Terms: Types and Purposes of Definitions²¹

Clearly defining terms is one way of helping to resolve problems of ambiguity and there are many types of definitions one can use:

- Lexical or dictionary definitions

The OED defines “defines” as...

- Disambiguating definitions

“When I said...I meant...”

- Stipulative definitions

For the purposes of this class, a “kwijybo” is “a big dumb balding North American ape with no chin and a short temper”

- Precising definitions

A small amount of salt is less than .5 tsp

- Systematic or theoretical

Brother-in-law: husband of my sister (OR brother of my wife!)

The point of using definitions like these is simple: to make sure that you are clear in what you say. If anything can be uncertain, it is best to define it or use other, more precise words.

We will be covering fallacies more later in this course, but there are a few that are very relevant right now, as these are all ones that can be fixed by using a definitional approach. Again, a “fallacy” is drawing an unsupported conclusion by using a common method of reasoning that is usually in error. Being familiar with fallacies makes them very easy to recognize (and avoid yourself, as well as understand how to properly resolve them).

Loaded Question Fallacy

(Also known as complex question, fallacy of presupposition, trick question) The fallacy of asking a question that has a presupposition built in, which implies something (often questionable) but protects the person asking the question from accusations of false claims or even slander.

Example: Have you stopped sleeping in unicorn sheets?

This question is a real ‘catch-22’ since to answer ‘yes’ implies that you used to sleep in unicorn sheets but have now stopped, and to answer ‘no’ means you are still sleeping in them. The question rests on the assumption that you sleep in unicorn sheets, and so either answer to it seems to endorse that idea.

Equivocation

(Also known as doublespeak) A fallacy that occurs when one uses an ambiguous term or phrase in more than one sense, thus rendering the argument misleading. The ambiguity in this fallacy is lexical and not grammatical, meaning the term or phrase that is ambiguous has two distinct meanings. In other words, it happens when one term is assumed to mean the same thing in two different contexts, but actually means two different things. One can often see equivocation in jokes.

Example: Man is the only rational animal, and no woman is a man, so women are not rational.

Example: If you don’t pay your exorcist you can get repossessed.

Example: A feather is light; whatever is light cannot be dark; therefore, a feather cannot be dark.

Amphiboly

A fallacy of ambiguity, where the ambiguity in question arises directly from the poor grammatical structure in a sentence. The fallacy occurs when a bad argument relies on the grammatical ambiguity to sound strong and logical.

Example: I’m going to return this car to the dealer I bought this car from. Their ad said “Used 1995 Ford Taurus with air conditioning, cruise, leather, new exhaust and chrome rims.” But the chrome rims aren’t new at all.

There are other kinds of amphiboly fallacies, like those of ambiguous pronoun reference: “I took some pictures of the dogs at the park playing, but they were not good.” Does ‘they’ mean the dogs or the pictures “were not good”? And there is amphiboly when modifiers are misplaced, such as in a famous Groucho Marx joke: “One morning I shot an elephant in my pajamas. How he got into my pajamas I’ll never know.”

Fallacy of the Undistributed Middle

(Also known as undistributed middle term) A formal fallacy that occurs in a categorical syllogism (we’ll look at these later), when the middle term is undistributed is not distributed at least in one premise. According to the rules of categorical syllogism, the middle term must be distributed at least once for it to be valid.

Example of the form: All X’s are Y’s; All Z’s are Y’s; Therefore, All X’s are Z’s.

Example in words: All ghosts are spooky; all zombies are spooky; therefore all ghosts are zombies.

The problem here is that you’re relating the incorrect categories with each other. It is fine to say, “All dogs are mammals, all mammals are animals, so all dogs are animals” but not “All dogs are mammals, all chihuahuas are mammals, so all chihuahuas are dogs” because even though your conclusion is true, the route that led you there is invalid.

This page titled [2.6: Defining Terms- Types and Purposes of Definitions](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#) .

CHAPTER OVERVIEW

3: Informal Fallacies - Mistakes in Reasoning

What is a fallacy? Simply put, a fallacy is an error in reasoning. It employs a method of reasoning to reach a conclusion that is usually incorrect, but the flaw isn't in the claims or conclusions, but rather in the connections between them (although the method of reasoning can sometimes go right in informal fallacies, formal fallacies are always wrong and those will be covered later). A fallacy can arise for two reasons:

1. When we mistakenly assume that we have proven our conclusion when we have not
2. When we assume we have stronger evidence for the conclusion than we really do

Hence, when you commit a fallacy it typically means that you lack in some way the proper evidence necessary to support your conclusion. A fallacy does not mean that the conclusion is necessary false, just that the premises provided are not strong enough to show that the conclusion is in fact true. There are also fallacies that have faulty inferences at their base, resulting in inappropriate logical steps leading to the claimed conclusion. Why should we study fallacies? First, and most importantly, so that you don't commit them. You want your reasoning to be proper, and the surest way to meet these goals is to avoid fallacies at all costs. Second, learning about fallacies is a great way to correct biases in your own reasoning that are maybe too deep to spot on your own. You'd be amazed how much bad reasoning you learn from parents, family, and friends, your culture, or the city you've been raised in. This brings me to the third point, you want to learn fallacies so you can see the errors in reasoning others commit: Politicians, lawyers, newspaper reporters, bloggers, Wikipedia, etc. are just some of the list. Many times, fallacies don't just happen on accident; they are often committed with some kind of intent or reaction in mind. Spotting them enables you to make clear and educated choices about who and what to believe, to prevent falling prey to schemes or false opinions, and will enable you to communicate more effectively with others.

[3.1: Classification of Fallacies - All the Ways we Say Things Wrong](#)

[3.2: Fallacies of Evidence](#)

[3.3: Fallacies of Weak Induction](#)

[3.4: Fallacies of Ambiguity and Grammatical Analogy](#)

[3.5: The Detection of Fallacies in Ordinary Language](#)

[3.6: Searching Your Essays for Fallacies](#)

This page titled [3: Informal Fallacies - Mistakes in Reasoning](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

3.1: Classification of Fallacies - All the Ways we Say Things Wrong

Again, the whole point of discussing fallacies is so that we are familiar with the common ways people go wrong with their reasoning so that we can (1) notice when others do it and (2) prevent ourselves from committing fallacies. There are general ways that we can think about fallacies, and approaching arguments with these things in mind will help you recognize fallacious reasoning even if you can't perfectly articulate where, why, and how something is going wrong. The three broad categories we'll use are:

1. Fallacies of evidence: these happen where the evidence presented doesn't relate to the argument or what is being presented as proper reasoning is unrelated to the topic, including misclassifying concepts or making overly broad or overly limited claims
2. Fallacies of weak induction: often referred to as "false causes" (latin: *non causa pro causa*), they occur when the evidence and claims don't actually provide enough strength to lead to the conclusions
3. Fallacies of ambiguity and grammatical analogy: these occur when someone makes use of something uncertain to make a certain claim without illustrating the appropriate connection or by using an inappropriate connection to go from the premises to the conclusion

Fallacies of evidence happen when the evidence provided just doesn't have much to do with the conclusion that the argument is trying to arrive at. In general, someone says something or gives evidence that is meant to deceive you into accepting the conclusion without actually giving you good *philosophical* reasons to accept it. You might want to accept it anyway for concerns having nothing to do with the argument. For example, an "Appeal to Force" is a common fallacy of this kind:

If you don't agree with me that potatoes are the most delicious food, then I'll smash your face in.

Smashing your face in has nothing to do with the deliciousness of potatoes, but you might be inclined to accept the argument nonetheless in order to spare your face from getting smashed in. However, the line of reasoning that led you there was inappropriate: you accepted the conclusion for a reason that has nothing to do with the reasons it should be accepted.

To avoid and spot these fallacies, you basically just have to ask yourself, "Do the claims I am presenting give someone an appropriate, specific, and direct reason to accept the truth of my conclusion?" If not then, then you might be committing a fallacy of evidence. If someone else does this, then you know that shouldn't accept their conclusion for the reasons they have presented. We will be covering these fallacies of evidence in more detail (though there are more fallacies than just what we cover here and these fallacies can also be interpreted to fall under other categories of fallacies – but bad reasoning is bad reasoning and it doesn't matter what category we put these in, as long as you recognize fallacious reasoning):

- Non Sequitur
- Red Herring
- Straw Man
- *Ad hominem*
- Naturalistic Fallacy
- Appeal to Authority
- Appeal to Force
- Appeal to Fear
- Appeal to Pity
- Appeal to Tradition
- Appeal to Novelty
- Appeal to Ignorance
- Appeal to Popularity

Fallacies of weak induction occur when the argument being presented just doesn't give strong enough reasons to accept the conclusion. Generally, the connection between the claims and the conclusion has not been shown to be strong enough to be convincing, but there are also more technical ways they can go wrong. There are also arguments that appear to say something, but don't, in which case, your acceptance of the conclusion has nothing to do with the arguments themselves.

Many of these can be termed "false causes" because the "causes" don't obviously lead to the "effects." A *Post hoc ergo propter hoc* (in English, "after this, therefore because of this") fallacy incorrectly posits causality on an event that occurred prior to another event, when the two are actually merely correlated. This sounds technical and complicated, but is actually rather simple. Here are two examples:

1. Shortly after broad social acceptance of homosexuality in Ancient Rome, the Roman Empire collapsed. Therefore, the acceptance of homosexuality caused the downfall of the Roman Empire.
2. Just Bieber's rise to stardom occurred after you were born, therefore your being born is the cause of Just Bieber's stardom.
Thank you for that.

Neither of these arguments are necessarily incorrect, but the line of reasoning employed and the evidence presented do not provide enough strength for us to accept the conclusion based on the premises. It's possible that these are good arguments, but just because something happens after something else doesn't mean it has caused it. A lot more evidence would need to be presented in order to establish (1) and (2) might be true if the person in question were one of Justin Bieber's parents.

A lot of these fallacies can get quite technical and require a keen eye for detail, but the general way to spot these is the same: Are the connections between the premises and the conclusions illustrated in a clear and strong enough fashion to be convincing? We will be covering these fallacies of weak induction in more detail (though there are more fallacies than just what we cover here and these fallacies can also be interpreted to fall under other categories of fallacies – but bad reasoning is bad reasoning and it doesn't matter what category we put these in, as long as you recognize fallacious reasoning):

- *Post hoc ergo propter hoc*
- Fallacy of Composition
- Fallacy of Division
- Hasty Generalization
- Begging the Question
- Circular Argument
- Self-Sealing Arguments

Fallacies of ambiguity and grammatical analogy occur when one attempts to prove a conclusion by using terms, concepts, or logical moves that are unclear and thus unjustifiably prove their conclusion because they're not obviously wrong. Again, this may sound complicated (and some of these fallacies are quite technical), but the idea is rather simple: a lack of clarity is abused to draw you to the conclusion without noticing that the path there was full of holes that you just didn't see. Sure, the path might actually be good in the end, but you haven't been given enough clarity to accept it.

We will be covering these fallacies of ambiguity and grammatical analogy in more detail (though there are more fallacies than just what we cover here and these fallacies can also be interpreted to fall under other categories of fallacies – but bad reasoning is bad reasoning and it doesn't matter what category we put these in, as long as you recognize fallacious reasoning):

- Loaded Question
- Equivocation
- Amphiboly
- Undistributed Middle
- Weak Analogy
- Vacuity
- False Dilemma

This page titled [3.1: Classification of Fallacies - All the Ways we Say Things Wrong](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#).

3.2: Fallacies of Evidence

Non Sequitur Fallacy (Latin for “does not follow”)

A logical fallacy that is most often absurd, where the premises have no logical connection with or relevance to the conclusion.

Example: The police have not been able to crack this homicide cold case, so they’ve called a psychic in to help out. They have tried all the traditional police investigation methods and the case still isn’t solved. Therefore, the psychic (the non-traditional method) is needed.

The general idea is that some evidence is being presented without its connection with the intended conclusion being illustrated in any way.

Red Herring (Latin: *Ignoratio elenchi*)

This fallacy involves the raising of an irrelevant issue in the middle of an argument, derailing the original discussion, and causing the argument to contain two totally different and unrelated issues. A red herring has happened when you begin your argument about one thing and end up arguing about something else entirely different. This fallacy renders any premises used logically unrelated to the conclusion. A red herring is a distraction tactic and is often used to avoid addressing criticism or attack by an opponent. This device is most commonly seen in political debates.

Example: The ‘Occupy Wall Street’ protesters complain that corporations and their money control Washington. But how can we take them seriously when their camps are messy, disorganized, with homeless people and drug addicts now living with them, and they are making life hell for the shop owners in their area?

Straw Man Fallacy

Like the red herring, a straw man tends to happen when one person is criticizing or attacking another’s position or argument. It occurs when a person misrepresents or purposely distorts the position or argument of their opponent in order to weaken it, thus defeating it more easily. The name vividly depicts the action: imagine two fighters in a ring, one of them builds a man made of straw (like a scarecrow), beats it up horribly, and then declares victory. While doing this, his or her real opponent stands in the ring, completely untouched. The straw man is considered to be one of the commonest fallacies; in particular we see it in widely used in political, religious, and ethical debates.

Example: The Leader of the Opposition is against the purchase of new submarines and helicopters. Clearly he is okay with our country being defenseless and open to invasion by our enemies. He also obviously hates our country. So, be ready to learn a new language and give up all our freedoms!

Abusing The Man (Ad hominem)

Any attempt to disprove a proposition or argument by launching a personal attack on the author of it. A person’s character does not necessarily predict the truth or falsity of a proposition or argument. There are many flavors of this fallacy and they all attempt to win an argument fallaciously:

Ad hominem denier – rejects the claim the person is making

Example: Mark said that Jill is the nicest person ever, but you should ignore everything Mark says.

Ad hominem silencer – rejects one’s ability to talk about the claim

Example: All of Marx’s economic doctrines are hogwash. But this was to be expected given he studied only philosophy in university, not business, and he never even held down a regular job.

Ad hominem dismisser – rejects the reliability of the speaker

Example: John said he saw me take the tacos, but he always lies about eating people’s food, so you shouldn’t trust him.

Tu quoque ad hominem (“You too”, or appeal to hypocrisy)

Example: Why should I listen to you when you tell me to stop drinking? You’re the biggest drunk I know!

Of course, if the person being attacked in an *ad hominem* really is guilty of the claim *and* it is relevant to the argument, then attacking them in this fashion is not fallacious.

Naturalistic Fallacy

(Latin: *argumentum ad Naturam*) A fallacy that occurs when a person bases their argument of position on the notion that what is natural is better or what 'ought to be'. In other words, the foundation for the argument or position is a value judgment; the fallacy happens when the argument shifts from a statement of fact to one of value. The word 'natural' is loaded with positive evaluation, like the word 'normal', so implied in the use of it is praise. One commonly sees this fallacy in moral arguments.

Example: It is only natural to feel angry sometimes; therefore there is nothing wrong with feeling angry.

Appeal to Authority

(Latin: *argumentum ad verecundiam*) An attempt to prove a conclusion by an improper appealing to an authority, and this appeal is considered improper when the authority is irrelevant and/or unrecognized.

Example: My mom says if I eat watermelon seeds, a plant will grow in my belly and I'll turn green. Because my mom said it, it is true.

It should be noted here that not all appeals to authority are faulty. When you are sick, you do visit your doctor and take their advice, and when you get into legal trouble you follow what a lawyer tells you. So, an appeal to authority can be relevant and proper when the authority you appeal to is (1) recognized as having authoritative expertise in that area, and (2) if we ourselves lack the information, the experience, or cannot firsthand acquire the information required ourselves for the argument. To appeal to statements made by Buzz Aldrin when speaking about the moon's surface is a proper application of authority. In general, you should ask

- Is the cited authority in fact an authority in the appropriate area?
- Is this the kind of question that can now be settled by expert consensus?
- Has the authority been cited correctly?
- Can the cited authority be trusted to tell the truth?
- Why is an appeal to authority being made at all?

Appeal to Force

(Latin: *argumentum ad baculum*) Any attempt to make someone accept a proposition or argument by using some type of force or threat, possibly including the threat of violence. After all, threats do not establish truth whatsoever.

Example: Company policy concerning customer feedback is "it's either perfect (100%) or we failed (99% or less)". Anyone who doesn't support this will be fired.

Appeal to Fear

Any attempt to make someone accept a proposition or argument by using fear related to the concept as a motivation.

Example: Do you want Al-Qaeda to take over the world? No? Then you should vote to increase military spending.

Appeal to Pity

(Latin: *argumentum ad misericordiam*) Any attempt to make someone accept a proposition or argument by arousing their emotions. A strong emotional appeal is meant to subvert someone's rational thinking. Remember: Pity alone does not establish truth.

Example: The defendant should not be found guilty of this crime. Her life has been filled with endless abuse, a lack of love and respect, and so many hardships.

Appeal to Tradition

(Latin: *argumentum ad antiquitatem*) This fallacy happens when someone cites the historical preferences and practices of a culture or even a particular person, as evidence for a proposition or argument being correct. Traditions are often passed down from generation to generation, with the explanation for continuity being "this is the way it has been done before", which is of course not a valid reason. The age of something does not entail its truth or falsity.

Example: We have turkey for Thanksgiving dinner and duck for Christmas dinner every year, because that is how my parents and grandparents did it, so it's the right thing to do.

Appeal to Novelty

(Latin: *argumentum ad novitatem*) This fallacy is the opposite of appeal to tradition, in that it is the attempt to claim that the newness or modernity of something is evidence of its truth and superiority. The novelty of the idea or proposition does not entail its truth or falsity.

Example: String Theory is a new and rising research area in particle physics, and therefore it must be true.

Appeal to Ignorance

(Latin: *argumentum ad Ignorantiam*) The attempt to argue for or against a proposition or position because there is a lack of evidence against or for it: I argue X because there is no evidence showing not-X.

Example: There is intelligent life on Neptune, for sure. Science has not found any evidence that there isn't life there.

Appeal to Popularity

(Latin: *argumentum ad numeram*) The attempt to use the popularity of a position or premise as evidence for its truthfulness. This is a fallacy because the popularity of something is irrelevant to its being true or false. It is one that sometimes is difficult to spot or prevent doing because common sense often dictates that if something is popular it must be true and/or valid.

Example: Eating quinoa daily is a healthy thing everyone is doing, so it must be the right choice.

Again, sometimes these can be non-fallacious. You have to ask the following questions:

- Is this opinion actually widely held?
- Is this the kind of area where popular opinion is likely to be right?
- Why is an appeal to popular opinion being made?

This page titled [3.2: Fallacies of Evidence](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) ([NGE Far Press](#)) .

3.3: Fallacies of Weak Induction

Post hoc ergo propter hoc

(Latin for “After this, therefore because of this”) This fallacy happens when one argues that because X happened immediately after Y, that Y was the cause of X. Or, when concerning event types: event type X happened immediately after event type Y, therefore event type Y caused event type X. In a sense, it is jumping to a conclusion based upon coincidence, rather than on sufficient testing, repeated occurrence, or evidence.

Example: The sun always rises a few minutes after the rooster crows. So, the rooster crowing causes the sun to rise.

Example: Once the government passed the new gun laws, gun violence dropped by 10%, therefore the new gun laws are working and caused the occurrence of gun violence to drop.

Fallacy of Composition

(Also known as exception fallacy) The fallacy of assuming that when a property applies to all members of a class, it must also apply to the class as a whole.

Example: Every player in the NHL is wealthy; therefore, the NHL must be a wealthy organization.

However, this type of reasoning is not always fallacious: Every scene in that movie is hilarious, so the movie is hilarious.

Fallacy of Division

(Also known as false division, or faulty division)

The fallacy of assuming that when a property applies to the class as a whole, it must also apply to every member of that class as well.

Example: The US Republican Party platform states that abortion is wrong and should be illegal. Therefore, every Republican must believe that abortion is wrong and should be illegal.

However, this type of reasoning is not always fallacious: That sculpture of Pee Wee Herman is made of metal, so his hand is made of metal.

Hasty Generalization

(Also known as argument from small numbers, unrepresentative sample) This fallacy occurs most often in the realm of statistics. It happens when a conclusion or generalization is drawn about a population and it is based on a sample that is too small to properly represent it. The problem with a sample that is too small is that the variability in a population is not captured, so the conclusion is inaccurate.

Example: My Grandfather drank a bottle of whiskey and smoked three cigars a day, and he lived to be 95 years old. Therefore, daily smoking and drinking cannot be that bad for you.

Begging the Question

(Latin: *Petitio Principii*) The fallacy of attempting to prove something by assuming the very thing you are trying to prove. Essentially, in order for one of the premises to be true, the conclusion must already be true. This is very similar to a circular argument (see below), but it is subtly different.

Example: The Bible is the word of God, God never lies, and the Bible says God exists, so God must exist. (Note: In order for the Bible to be the word of God, you must assume God exists – but isn’t that your conclusion?)

Example #2: It’s always wrong to murder human beings. Capital punishment involves murdering human beings. Therefore, capital punishment is wrong.

Note that this is NOT “raising the question” as “begging the question” is often used:

“He always carries around a knife, that begs the question, what he is scared of?”

Circular argument

The fallacy of proving something that you've already assumed. Basically, your conclusion has already appeared as an assumption.

Example: All of the statements in Smith's book *Crab People Walk Among Us* are true. Why, he even says in the preface that his book only contains true statements and firsthand stories.

Self-sealers

A self-sealing argument is one that cannot possibly be wrong for one reason or another. Definitional arguments or claims and conspiracy theories are perfect examples.

Example ("true by definition"): The following is a clear example of a self-sealing statement: Two weeks from today at 4:37 PM you are going to be doing *exactly* what you will be doing.

Example #2 ("universal discounting"): Aliens exist and the only reason we don't think they exist is because they're making us believe that.

So how do you deal with self-sealers? The best way is to just ignore them or not start an argument with someone who uses them in the first place. Also called "going upstairs" because instead of staying downstairs and speaking with a highly irrational person, you'd rather just go upstairs, put your headphones, and listen to some Nickelback. This would appear to be the only situation where listening to Nickelback is preferable to the alternative. (Am I committing fallacy here in this line of reasoning?)

This page titled [3.3: Fallacies of Weak Induction](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

3.4: Fallacies of Ambiguity and Grammatical Analogy

Loaded Question Fallacy

(Also known as complex question, fallacy of presupposition, trick question) The fallacy of asking a question that has a presupposition built in, which implies something (often questionable) but protects the person asking the question from accusations of false claims or even slander.

Example: Have you stopped beating your wife yet?

This question is a real ‘catch 22’ since to answer ‘yes’ implies that you used to beat your wife but have now stopped, and to answer ‘no’ means you are still beating her. The question rests on the assumption that you beat your wife, and so either answer to it seems to endorse that idea.

Equivocation

(Also known as doublespeak) A fallacy that occurs when one uses an ambiguous term or phrase in more than one sense, thus rendering the argument misleading. The ambiguity in this fallacy is lexical and not grammatical, meaning the term or phrase that is ambiguous has two distinct meanings. In other words, it happens when one term is assumed to mean the same thing in two different contexts, but actually means two different things. One can often see equivocation in jokes.

Example: Man is the only rational animal, and no woman is a man, so women are not rational.

Example: If you don’t pay your exorcist you can get repossessed.

Example: A feather is light; whatever is light cannot be dark; therefore, a feather cannot be dark.

Amphiboly

A fallacy of ambiguity, where the ambiguity in question arises directly from the poor grammatical structure in a sentence. The fallacy occurs when a bad argument relies on the grammatical ambiguity to sound strong and logical.

Example: I’m going to return this car to the dealer I bought this car from. Their ad said “Used 1995 Ford Taurus with air conditioning, cruise, leather, new exhaust and chrome rims.” But the chrome rims aren’t new at all.

There are other kinds of amphiboly fallacies, like those of ambiguous pronoun reference: “I took some pictures of the dogs at the park playing, but they were not good.” Does ‘they’ mean the dogs or the pictures “were not good”? And there is amphiboly when modifiers are misplaced, such as in a famous Groucho Marx joke: “One morning I shot an elephant in my pajamas. How he got into my pajamas I’ll never know.”

Fallacy of the Undistributed Middle

(Also known as undistributed middle term) A formal fallacy that occurs in a categorical syllogism (we’ll look at these next week), when the middle term is undistributed is not distributed at least in one premise. According to the rules of categorical syllogism, the middle term must be distributed at least once for it to be valid.

Example of the form: All X’s are Y’s; All Z’s are Y’s; Therefore, All X’s are Z’s.

Example in words: All ghosts are spooky; all zombies are spooky; therefore all ghosts are zombies.

Weak Analogy

(Also known as faulty analogy, questionable analogy) While arguments from analogy will be covered in more detail later in this work, it is worth covering the fallacy of weak analogies right now. When someone uses an analogy to prove or disprove an argument or position by using an analogy that is too dissimilar to be effective. Two important things to remember about analogies: No analogy is perfect, and even the most dissimilar objects can share some commonality or similarity. Analogies are neither true nor false, but come in degrees from identical or similar to extremely dissimilar or different.

Example: Not believing in the monster under the bed because you have yet to see it is like not believing the Titanic sank because no one saw it hit the bottom.

Vacuity

Vacuous arguments are arguments that say nothing. Here is generally the correct format of argumentation:

- *A* asserts that *p* is true. - *B* raises objections *x*, *y*, and *z* against it. - *A* then offers reasons to overcome these objections.

Vacuous arguments don't exactly follow this format. Vacuous arguments don't really make an argument – they don't add anything to our knowledge. They don't make a series of statements and point them at something new. For this reason, you can't exactly argue with them – you can point out the flaw in reasoning, but there isn't really an argument to refute.

Example: John, "Coconuts are the best food ever." Jack, "I once had a cat named Coconut."

False Dilemma

(Also known as false dichotomy, black-and-white fallacy) A fallacy that happens when only two choices are offered in an argument or proposition, when in fact a greater number of possible choices exist between the two extremes. False dilemmas typically contain 'either, or' in their structure. They often try to force the person into adopting one of the positions by making one option unacceptable.

Example: Either you help us kill the zombies, or you love them.

This page titled [3.4: Fallacies of Ambiguity and Grammatical Analogy](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) ([NGE Far Press](#)) .

3.5: The Detection of Fallacies in Ordinary Language

17 The Detection of Fallacies in Ordinary Language³¹

Fallacies occur constantly, and there is no better place to see them in a political debate. Observe 5 minutes of any political debate between 2 or more candidates and do the following:

1) When a fallacy is said, pause the video, mark down the fallacy by noting what type of fallacy it is. 2) Identify the conclusion that the person was trying to reach and the premises being used to reach that conclusion. 3) Why do you think the fallacy was committed? Was it on accident or on purpose? 4) Is there a way of fixing the argument to avoid fallacies? 5) Did committing the fallacy hurt the candidate's overall strength in the debate? Why or why not?

You should have at least 20 fallacies after 5 minutes if you were paying close attention. Yes, that's how common fallacies are even for the best orators.

Here is an excellent visual example of recognizing fallacies in real life. It is too large and complicated to be printed here, but it is a categorization of fallacies in a paper written against Same Sex Marriage by a Catholic Bishop. It is a very detailed and careful analysis and is a good example of just how many fallacies are committed in public debates and how committing the argument itself may sound appealing to many people before recognizing the extent to which the argument is fallacious:

This page titled [3.5: The Detection of Fallacies in Ordinary Language](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

3.6: Searching Your Essays for Fallacies

18 Searching Your Essays for Fallacies³²

When it comes to writing your own arguments and finding fallacies, it can be hard to spot them yourself. It is often very helpful to have someone else read through it and spot fallacies for you (assuming they have training in logic). However, if you are attempting to find and resolve any fallacies for yourself in your own essays, you should do the following:

1) Whenever you are making an argument, clearly identify the conclusion you are trying to reach and the premises you are using to arrive at the conclusion. 2) Check the premises to see if they are actually relevant in the argument you are making and if they all connect to each other. 3) Check to see that the premises actually lead to the conclusion in the right ways to support it.

Going through your essay slowly and carefully in this fashion can help you find and fix any fallacies before others even see them. Mostly, you just need to be sure that what you're saying actually does properly lead to the conclusions you are attempting to convince others to accept. Usually you'll go wrong by bringing in claims that just don't matter for what you're saying. Here's the most important thing to remember about relevance of the claims when it comes to writing argumentative essays: If you say something that doesn't relate to your argument, I *really* don't care. Why, you ask? Because it would be irrelevant. Like if I say, "My friend Steve Weimer is the best fantasy baseball player I know because he always wins, he follows every game, he's won major tournaments, and he's six feet tall." Being six feet tall has nothing to do with being good at fantasy baseball – at least I truly hope not, or I'm doomed to failure.

This page titled [3.6: Searching Your Essays for Fallacies](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#).

CHAPTER OVERVIEW

4: Deductive Arguments

Logic is the business of evaluating arguments, sorting good ones from bad ones. In everyday language, we sometimes use the word ‘argument’ to refer to belligerent shouting matches. If you and a friend have an argument in this sense, things are not going well between the two of you.

- [4.1: Prelude to Deductive Arguments](#)
- [4.2: Statements and Symbolizing](#)
- [4.3: Propositions, Inferences, and Judgments](#)
- [4.4: Validity and Soundness](#)
- [4.5: Commons Forms of Arguments](#)
- [4.6: Formal Fallacies](#)
- [4.7: Formalizing your Arguments](#)

This page titled [4: Deductive Arguments](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) ([NGE Far Press](#)) .

4.1: Prelude to Deductive Arguments

What is logic?³³

Logic is the business of evaluating arguments, sorting good ones from bad ones. In everyday language, we sometimes use the word ‘argument’ to refer to belligerent shouting matches. If you and a friend have an argument in this sense, things are not going well between the two of you.

In logic, we are not interested in the teeth-gnashing, hair-pulling kind of argument. A logical argument is structured to give someone a reason to believe some conclusion. Here is one such argument:

- (1) It is raining heavily.
- (2) If you do not take an umbrella, you will get soaked.
- ∴ You should take an umbrella.

The three dots on the third line of the argument mean ‘Therefore’ and they indicate that the final sentence is the conclusion of the argument. The other sentences are premises of the argument. If you believe the premises, then the argument provides you with a reason to believe the conclusion.

This chapter discusses some basic logical notions that apply to arguments in a natural language like English. It is important to begin with a clear understanding of what arguments are and of what it means for an argument to be valid. Later we will translate arguments from English into a formal language. We want formal validity, as defined in the formal language, to have at least some of the important features of natural-language validity.

Arguments

When people mean to give arguments, they typically often use words like ‘therefore’ and ‘because.’ When analyzing an argument, the first thing to do is to separate the premises from the conclusion. Words like these are a clue to what the argument is supposed to be, especially if— in the argument as given— the conclusion comes at the beginning or in the middle of the argument.

premise indicators: since, because, given that conclusion indicators: therefore, hence, thus, then, so

To be perfectly general, we can define an argument as a series of sentences. The sentences at the beginning of the series are premises. The final sentence in the series is the conclusion. If the premises are true and the argument is a good one, then you have a reason to accept the conclusion.

Notice that this definition is quite general. Consider this example:

There is coffee in the coffee pot. There is a dragon playing bassoon on the armoire. ∴ Salvador Dali was a poker player.

It may seem odd to call this an argument, but that is because it would be a terrible argument. The two premises have nothing at all to do with the conclusion. Nevertheless, given our definition, it still counts as an argument— albeit a bad one.

Sentences

In logic, we are only interested in sentences that can figure as a premise or conclusion of an argument. So we will say that a sentence is something that can be true or false.

You should not confuse the idea of a sentence that can be true or false with the difference between fact and opinion. Often, sentences in logic will express things that would count as facts— such as ‘Kierkegaard was a hunchback’ or ‘Kierkegaard liked almonds.’ They can also express things that you might think of as matters of opinion— such as, ‘Almonds are yummy.’

Also, there are things that would count as ‘sentences’ in a linguistics or grammar course that we will not count as sentences in logic.

Questions

In a grammar class, ‘Are you sleepy yet?’ would count as an interrogative sentence. Although you might be sleepy or you might be alert, the question itself is neither true nor false. For this reason, questions will not count as sentences in logic. Suppose you answer the question: ‘I am not sleepy.’ This is either true or false, and so it is a sentence in the logical sense. Generally, questions will not count as sentences, but answers will.

‘What is this course about?’ is not a sentence. ‘No one knows what this course is about’ is a sentence.

Imperatives

Commands are often phrased as imperatives like ‘Wakeup!’, ‘Sit up straight’, and so on. In a grammar class, these would count as imperative sentences. Although it might be good for you to sit up straight or it might not, the command is neither true nor false. Note, however, that commands are not always phrased as imperatives. ‘You will respect my authority’ is either true or false—either you will or you will not—and so it counts as a sentence in the logical sense.

Exclamations ‘Ouch!’ is sometimes called an exclamatory sentence, but it is neither true nor false. We will treat ‘Ouch, I hurt my toe!’ as meaning the same thing as ‘I hurt my toe.’ The ‘ouch’ does not add anything that could be true or false.

Two ways that arguments can go wrong

Consider the argument that you should take an umbrella (presented previously). If premise (1) is false— if it is sunny outside— then the argument gives you no reason to carry an umbrella. Even if it is raining outside, you might not need an umbrella. You might wear a rain pancho or keep to covered walkways. In these cases, premise (2) would be false, since you could go out without an umbrella and still avoid getting soaked.

Suppose for a moment that both the premises are true. You do not own a rain pancho. You need to go places where there are no covered walkways. Now does the argument show you that you should take an umbrella? Not necessarily. Perhaps you enjoy walking in the rain, and you would like to get soaked. In that case, even though the premises were true, the conclusion would be false.

For any argument, there are two ways that it could be weak. First, one or more of the premises might be false. An argument gives you a reason to believe its conclusion only if you believe its premises. Second, the premises might fail to support the conclusion. Even if the premises were true, the form of the argument might be weak. The example we just considered is weak in both ways.

When an argument is weak in the second way, there is something wrong with the logical form of the argument: Premises of the kind given do not necessarily lead to a conclusion of the kind given. We will be interested primarily in the logical form of arguments.

Consider another example:

You are reading this book. This is a logic book. ∴ You are a logic student.

This is not a terrible argument. Most people who read this book are logic students. Yet, it is possible for someone besides a logic student to read this book. If your roommate picked up the book and thumbed through it, they would not immediately become a logic student. So the premises of this argument, even though they are true, do not guarantee the truth of the conclusion. Its logical form is less than perfect.

An argument that had no weakness of the second kind would have perfect logical form. If its premises were true, then its conclusion would necessarily be true. We call such an argument ‘deductively valid’ or just ‘valid.’

Even though we might count the argument above as a good argument in some sense, it is not valid; that is, it is ‘invalid.’ One important task of logic is to sort valid arguments from invalid arguments.

Deductive validity

An argument is deductively valid if and only if it is impossible for the premises to be true and the conclusion false.

The crucial thing about a valid argument is that it is impossible for the premises to be true at the same time that the conclusion is false. Consider this example:

Oranges are either fruits or musical instruments. Oranges are not fruits. ∴ Oranges are musical instruments.

The conclusion of this argument is ridiculous. Nevertheless, it follows validly from the premises. This is a valid argument. If both premises were true, then the conclusion would necessarily be true.

This shows that a deductively valid argument does not need to have true premises or a true conclusion. Conversely, having true premises and a true conclusion is not enough to make an argument valid. Consider this example:

London is in England. Beijing is in China. ∴ Paris is in France.

The premises and conclusion of this argument are, as a matter of fact, all true. This is a terrible argument, however, because the premises have nothing to do with the conclusion. Imagine what would happen if Paris declared independence from the rest of France. Then the conclusion would be false, even though the premises would both still be true. Thus, it is logically possible for the premises of this argument to be true and the conclusion false. The argument is invalid.

The important thing to remember is that validity is not about the actual truth or falsity of the sentences in the argument. Instead, it is about the form of the argument: The truth of the premises is incompatible with the falsity of the conclusion.

4.1: Prelude to Deductive Arguments is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by LibreTexts.

4.2: Statements and Symbolizing

Sentential logic

The version of logical language we're using is often called Sentential Logic or SL. It is called sentential logic, because the basic units of the language will represent entire sentences.

Sentence letters

In SL, capital letters are used to represent basic sentences. Considered only as a symbol of SL, the letter A could mean any sentence. So when translating from English into SL, it is important to provide a symbolization key. The key provides an English language sentence for each sentence letter used in the symbolization. For example, consider this argument:

There is an apple on the desk.

If there is an apple on the desk, then Jenny made it to class.

∴ Jenny made it to class.

This is obviously a valid argument in English. In symbolizing it, we want to preserve the structure of the argument that makes it valid. What happens if we replace each sentence with a letter? Our symbolization key would look like this:

A: There is an apple on the desk.

B: If there is an apple on the desk, then Jenny made it to class.

C: Jenny made it to class.

We would then symbolize the argument in this way:

A

B

∴C

There is no necessary connection between some sentence A, which could be any sentence, and some other sentences B and C, which could be any sentences. The structure of the argument has been completely lost in this translation. The important thing about the argument is that the second premise is not merely any sentence, logically divorced from the other sentences in the argument. The second premise contains the first premise and the conclusion as parts. Our symbolization key for the argument only needs to include meanings for A and C, and we can build the second premise from those pieces. So we symbolize the argument this way:

A

If A, then C.

∴C

This preserves the structure of the argument that makes it valid, but it still makes use of the English expression 'If... then...'. Although we ultimately want to replace all of the English expressions with logical notation, this is a good start.

The sentences that can be symbolized with sentence letters are called atomic sentences, because they are the basic building blocks out of which more complex sentences can be built. Whatever logical structure a sentence might have is lost when it is translated as an atomic sentence. From the point of view of SL, the sentence is just a letter. It can be used to build more complex sentences, but it cannot be taken apart.

There are only twenty-six letters of the alphabet, but there is no logical limit to the number of atomic sentences. We can use the same letter to symbolize different atomic sentences by adding a subscript, a small number written after the letter. We could have a symbolization key that looks like this:

A1: The apple is under the armoire.

A2: Arguments in SL always contain atomic sentences.

A3: Adam Ant is taking an airplane from Anchorage to Albany.

...

A294: Alliteration angers otherwise affable astronauts.

Keep in mind that each of these is a different sentence letter. When there are subscripts in the symbolization key, it is important to keep track of them.

Here is an interesting thing to note, and it makes sense. Whenever a variable is defined, we use capital letters and you can use any one you want, and it is often a good idea to choose one that represents the sentence well, like using B for “Barbara is awesome.” However, when we are

talking abstractly or discussing rules in general, we use lower-case letters, italicize them, and often start with p and go from there.

Connectives

Logical connectives are used to build complex sentences from atomic components. There are five logical connectives in SL. They are summarized below. Today we’re looking at the first 3 and we’ll be looking at the other 2 in another lesson.

$\sim$ = negation: ‘It is not the case that p’, $\sim p$

$\&$ = conjunction: ‘Both p and q’ $p \& q$

$\vee$ = disjunction: ‘Either p or q’ $p \vee q$ (yes, that’s just a lower case v, but technically it’s a different character)

$\supset$ = conditional: ‘If p then...q’ $p \supset q$ (you can copy and paste “ $\supset$ ” or you can use $>$)

$\leftrightarrow$ = biconditional: ‘p if and only if q’ $p \leftrightarrow q$ (you can copy and paste “ $\leftrightarrow$ ” or you can use $<>$)

Negation

Consider how we might symbolize these sentences:

1. Mary is in Barcelona.
2. Mary is not in Barcelona.
3. Mary is somewhere besides Barcelona.

In order to symbolize sentence 1, we will need one sentence letter. We can provide a symbolization key:

B: Mary is in Barcelona.

Note that here we are giving B a different interpretation than we did in the previous section. The symbolization key only specifies what B means in a specific context. It is vital that we continue to use this meaning of B so long as we are talking about Mary and Barcelona. Later, when we are symbolizing different sentences, we can write a new symbolization key and use B to mean something else.

Now, sentence 1 is simply B.

Since sentence 2 is obviously related to the sentence 1, we do not want to introduce a different sentence letter. To put it partly in English, the sentence means ‘Not B.’ In order to symbolize this, we need a symbol for logical negation. We will use $\sim$.

Now we can translate ‘Not B’ to $\sim B$, which is sentence 2.

Sentence 3 is about whether or not Mary is in Barcelona, but it does not contain the word ‘not.’ Nevertheless, it is logically equivalent to sentence 2.

They both mean: It is not the case that Mary is in Barcelona.

As such, we can translate both sentence 2 and sentence 3 as $\sim B$. A sentence can be symbolized as $\sim A$ if it can be paraphrased in English as ‘It is not the case that A.’ Consider these further examples:

4. The widget can be replaced if it breaks.
5. The widget is irreplaceable.
6. The widget is not irreplaceable.

If we let R mean ‘The widget is replaceable’, then sentence 4 can be translated as R.

What about sentence 5? Saying the widget is irreplaceable means that it is not the case that the widget is replaceable. So even though sentence 5 is not negative in English, we symbolize it using negation as $\sim R$.

Sentence 6 can be paraphrased as 'It is not the case that the widget is irreplaceable.' Using negation twice, we translate this as $\sim R$. The two negations in a row each work as negations, so the sentence means 'It is not the case that it is not the case that R.' If you think about the sentence in English, it is logically equivalent to sentence 4. So when we define logical equivalence in SL, we will make sure that R and $\sim\sim R$ are logically equivalent.

More examples:

7. Elliott is happy.

8. Elliott is unhappy.

If we let H mean 'Elliott is happy', then we can symbolize sentence 7 as H . However, it would be a mistake to symbolize sentence 8 as $\sim H$. If Elliott is unhappy, then he is not happy, but sentence 8 does not mean the same thing as 'It is not the case that Elliott is happy.' It could be that he is not happy but that he is not unhappy either. Perhaps he is somewhere between the two. In order to symbolize sentence 8, we would need a new sentence letter.

For any sentence A : If A is true, then $\sim A$ is false. If $\sim A$ is true, then A is false.

Using 'T' for true and 'F' for false, we can summarize this in a characteristic truth table for negation:

$A \quad \sim A$

T F

F T

Conjunction

Consider these sentences:

9. Adam is athletic.

10. Barbara is athletic.

11. Adam is athletic, and Barbara is also athletic.

We will need separate sentence letters for 9 and 10, so we define this symbolization key:

A : Adam is athletic.

B : Barbara is athletic.

Sentence 9 can be symbolized as A .

Sentence 10 can be symbolized as B .

Sentence 11 can be paraphrased as 'A and B.' In order to fully symbolize this sentence, we need another symbol. We will use '&.' We translate 'A and B' as $A \& B$. The logical connective '&' is called conjunction, and A and B are each called conjuncts.

Notice that we make no attempt to symbolize 'also' in sentence 11. Words like 'both' and 'also' function to draw our attention to the fact that two things are being conjoined. They are not doing any further logical work, so we do not need to represent them in SL.

Some more examples:

12. Barbara is athletic and energetic.

13. Barbara and Adam are both athletic.

14. Although Barbara is energetic, she is not athletic.

15. Barbara is athletic, but Adam is more athletic than she is.

Sentence 12 is obviously a conjunction. The sentence says two things about Barbara, so in English it is permissible to refer to Barbara only once. It might be tempting to try this when translating the argument: Since B means 'Barbara is athletic', one might paraphrase the sentences as 'B and energetic.' This would be a mistake. Once we translate part of a sentence as B , any further structure is lost. B is an atomic sentence; it is nothing more than true or false. Conversely, 'energetic' is not a sentence; on its own it is neither true nor false. We should instead paraphrase the sentence as 'B and Barbara is energetic.' Now we need to add a sentence letter to the symbolization key. Let E mean 'Barbara is energetic.' Now the sentence can be translated as $B \& E$. A sentence can be symbolized as $A \& B$ if it can be paraphrased

in English as 'Both A, and B.' Each of the conjuncts must be a sentence.

Sentence 13 says one thing about two different subjects. It says of both Barbara and Adam that they are athletic, and in English we use the word 'athletic' only once. In translating to SL, it is important to realize that the sentence can be paraphrased as, 'Barbara is athletic, and Adam is athletic.' This translates as B & A.

Sentence 14 is a bit more complicated. The word 'although' sets up a contrast between the first part of the sentence and the second part. Nevertheless, the sentence says both that Barbara is energetic and that she is not athletic. In order to make each of the conjuncts an atomic sentence, we need to replace 'she' with 'Barbara.'

So we can paraphrase sentence 14 as, 'Both Barbara is energetic, and Barbara is not athletic.' The second conjunct contains a negation, so we paraphrase further: 'Both Barbara is energetic and it is not the case that Barbara is athletic.' This translates as E & B.

Sentence 15 contains a similar contrastive structure. It is irrelevant for the purpose of translating to SL, so we can paraphrase the sentence as 'Both Barbara is athletic, and Adam is more athletic than Barbara.' (Notice that we once again replace the pronoun 'she' with her name.) How should we translate the second conjunct? We already have the sentence letter A which is about Adam's being athletic and B which is about Barbara's being athletic, but neither is about one of them being more athletic than the other. We need a new sentence letter. Let

R mean 'Adam is more athletic than Barbara.' Now the sentence translates as B & R.

Sentences that can be paraphrased 'A, but B' or 'Although A, B' are best symbolized using conjunction: A & B. It is important to keep in mind that the sentence letters A, B, and R are atomic sentences. Considered as symbols of SL, they have no meaning beyond being true or false. We have used them to symbolize different English language sentences that are all about people being athletic, but this similarity is completely lost when we translate to SL. No formal language can capture all the structure of the English language, but as long as this structure is not important to the argument there is nothing lost by leaving it out.

Which of these three statements are saying the same thing?

- 1) Mike and George are boxers
- 2) Mike is a boxer and George is a boxer
- 3) Mike and George are boxing each other

The first 2 are the same – but the third says something different. Although it involves the word "and" it is not being used as a conjunction. It is telling us that they are partaking in an action with the other. If we were to treat it as a conjunction, it would be: Mike is boxing each other and George is boxing each other. However, we could say that this sentence is saying, "Mike is boxing George and George is boxing Mike", but this is changing things up a bit. However, the

two sentences would be expressing nearly the same ideas. Remember that a conjunction just joins two propositions.

For any sentences A and B, A & B is true if and only if both A and B are true. We can summarize this in the characteristic truth table for conjunction:

A B A & B

T T T

T F F

F T F

F F F

Conjunction is symmetrical because we can swap the conjuncts without changing the truth-value of the sentence. Regardless of what A and B are, A & B is logically equivalent to B & A.

Are these valid arguments?

"Harry is short and John is tall, therefore Harry is short."

"Harry is short. John is tall. Therefore, Harry is short and John is tall."

They are both valid. Think about validity means and then about what is being said. Remember that in a valid argument, if the premises are true, the conclusion must also be true. In other words, if the premises are true, there is no way that the conclusion can

ever be false. So, with both of these arguments, if the premises are true, the conclusions have to be true as well. Thus, they are valid. They are sound if Harry is actually short and John is actually tall, but when doing symbolic logic, we just care about validity. Soundness is much too practical and important.

Looking into the future, this is what truth tables will be telling us: we'll be making complex ones that will let us know when all of the premises are true, and if the conclusion is true every time that the premises are all true, then the argument is valid.

Disjunction

Consider these sentences:

16. Either Denison will play golf with me, or he will watch movies.

17. Either Denison or Ellery will play golf with me.

For these sentences we can use this symbolization key:

D: Denison will play golf with me.

E: Ellery will play golf with me.

M: Denison will watch movies.

Sentence 16 is 'Either D or M.' To fully symbolize this, we introduce a new symbol. The sentence becomes $D \vee M$. The ' $\vee$ ' connective is called disjunction, and D and M are called disjuncts.

Sentence 17 is only slightly more complicated. There are two subjects, but the English sentence only gives the verb once. In translating, we can paraphrase it as. 'Either Denison will play golf with me, or Ellery will play golf with me.' Now it obviously translates as $D \vee E$.

A sentence can be symbolized as $A \vee B$ if it can be paraphrased in English as 'Either A, or B.' Each of the disjuncts must be a sentence.

Sometimes in English, the word 'or' excludes the possibility that both disjuncts are true. This is called an exclusive or. An exclusive or is clearly intended when it says, on a restaurant menu, 'Entrees come with either soup or salad.' You may have soup; you may have salad; but, if you want both soup and salad, then you have to pay extra.

At other times, the word 'or' allows for the possibility that both disjuncts might be true. This is probably the case with sentence 17, above. I might play with Denison, with Ellery, or with both Denison and Ellery. Sentence 17 merely says that I will play with at least one of them. This is called an inclusive or.

The symbol ' $\vee$ ' represents an inclusive or. So $D \vee E$ is true if D is true, if E is true, or if both D and E are true. It is false only if both D and E are false. We can summarize this with the characteristic truth table for disjunction:

A B $A \vee B$

T T T

T F T

F T T

F F F

Like conjunction, disjunction is symmetrical. $A \vee B$ is logically equivalent to $B \vee A$.

These sentences are somewhat more complicated:

18. Either you will not have soup, or you will not have salad.

19. You will have neither soup nor salad.

20. You get either soup or salad, but not both.

We let S1 mean that you get soup and S2 mean that you get salad.

Sentence 18 can be paraphrased in this way: 'Either it is not the case that you get soup, or it is not the case that you get salad.' Translating this requires both disjunction and negation. It becomes $\neg S1 \vee \neg S2$.

Sentence 19 also requires negation. It can be paraphrased as, 'It is not the case that either that you get soup or that you get salad.' We need some way of indicating that the negation does not just negate the right or left disjunct, but rather negates the entire disjunction. In order to do this, we put parentheses around the disjunction: 'It is not the case that (S1 $\vee$ S2).' This becomes simply $\sim$ (S1 $\vee$ S2). Notice that the parentheses are doing important work here. The sentence $\sim$ S1 $\vee$ S2 would mean 'Either you will not have soup, or you will have salad.'

Sentence 20 is an exclusive or. We can break the sentence into two parts. The first part says that you get one or the other. We translate this as (S1 $\vee$ S2). The second part says that you do not get both. We can paraphrase this as, 'It is not the case both that you get soup and that you get salad.' Using both negation and conjunction, we translate this as $\sim$ (S1 & S2). Now we just need to put the two parts together. As we saw above, 'but' can usually be translated as a conjunction. Sentence 20 can thus be translated as (S1 $\vee$ S2) & $\sim$ (S1 & S2).

Although ' $\vee$ ' is an inclusive or, we can symbolize an exclusive or in SL. We just need more than one connective to do it.

Parentheses

You must use parenthesis in logic like you might anywhere else. AS the previous example showed you, leaving them out can completely change the meaning of a sentence. The rules are simple: use parentheses to connect only 2 statements at a time and when 2 things are in a parentheses, they basically become one thing. So, if I wanted to symbolize

"Adam went to the store, Mark went to the play, John did not go to the store, and Belle did not go to the play" we could write

(A & M) & ($\sim$ J & $\sim$ B) or

A & (M & ($\sim$ J & $\sim$ B)) or a whole lot of other ways by shifting around parentheses.

(I'll leave it to you to figure out what each letter represents)

This page titled [4.2: Statements and Symbolizing](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NCE Far Press) .

4.3: Propositions, Inferences, and Judgments

20 Propositions, Inferences, and Judgments³⁵

Consider the following two statements:

- She is annoying, but I love her. - I love her, but she is annoying.

What is being said here? Technically speaking, “but” functions as a conjunction and the two sentences mean logically the exact same thing. They mean, “I love her and she is annoying” and nothing more. It is difficult to capture the subtleties of language in logical systems sometimes, and this is one example. In the first case, the emphasis is on love, and in the second case, it is on annoyance. Today’s Lesson is about some of the subtleties of language and how we understand logic on a day-to-day basis in our ordinary language. While the proposition (a statement that is subject to being True or False) says one thing technically, its regular-language meaning is significantly different. Judgments are when we determine whether the statement is actually True or False. So determining the Truth of the above statement would be one thing in Logic, and another in real-life. Why do we care about the Truth or Falsity of statements? Because knowing whether they are True or False allows us to figure out what else we know. Regardless of their being True or False, there are inferences (statements that necessarily follow from assuming certain statements are True) that we can understand. The process is generally the same: given what we’ve been told, what else can we infer? Logical equivalency means that two statements are Truth-functionally equivalent, which means that they are both True under all the same circumstances. Essentially, this means that whenever one of them is True, the other is True as well. If we can understand which statements are logically equivalent, then we can understand the basic idea of entailments. Single statements can give us some inferences like equivalency, and this is where we will begin before moving to more complex inferences in the forms of proofs and deductions. For now, we’re going to get into some more detail on disjunctions in order to understand what we can infer and understand from basic statements.

Exclusive vs. Nonexclusive Disjunctions³⁶

NOTE: $\cdot$ = & in the text below. There are different notations and in some of them they use $\cdot$ to represent conjunctions.

The connectives “or” and “either ... or” are used in two distinct ways in daily discourses. When a host asks you “Coffee or Tea?”, it is implicitly implied that you should choose coffee or tea, but not both. The connective “or” is used in the exclusive sense to mean “one or the other, but not both.” Afterwards, when the host asks you again “Cream or sugar?”, you can respond by saying “Both, please.” Now the connective is used in the nonexclusive sense of “one or the other, or both.”

Here is an example of “either ... or ...” used in the nonexclusive sense:

Either fire or smoke can damage the paintings.

$F \vee S$

F: Fire can damage the paintings.

S: Smoke can damage the paintings.

If either fire or smoke alone can damage the paintings, then the two together can damage the paintings.

In Propositional Logic, the wedge “ $\vee$ ” is used to symbolize nonexclusive disjunctions. So the sentence is symbolized as $F \vee S$.

By contrast, in the next sentence “either ... or ...” is used in the exclusive sense.

The Federal Reserve will either raise interest rates or leave them intact.

$\sim(R \cdot L)$

R: The Federal Reserve will raise interest rates.

L: The Federal Reserve will leave interest rates intact.

$\sim(R \cdot L)$. The first conjunct $R \vee L$ means that the Federal Reserve will do one or the other, or both. But the second conjunct $\sim(R \cdot L)$ says that the Federal Reserve will not do both. So together, they capture the meaning of “one or the other, but not both.”

How to Symbolize “unless”

A compound sentence formed with the connective “unless” can be symbolized as a conditional or a biconditional, depending on the meaning of the sentence. It can also be symbolized as a disjunction. But in doing so, we need to pay attention to whether it is the

exclusive or the nonexclusive disjunction. The sentence

Jeff cannot graduate unless he completes all the GE requirements.

We can also rewrite this as

Either Jeff completes all the GE requirements or he cannot graduate.

$\sim G \sim G$, because it is possible that Jeff completes all the GE requirements but still cannot graduate due to, say, having not yet met the total unit requirement. $\sim G$ is logically equivalent to $\sim G \vee C$. As a result, we can symbolize it as $\sim G \vee C$.

Jeff cannot graduate unless he completes all the GE requirements.

$\sim G \vee C$

“Not ... both ...” and “Both ... not ...”

It is important not to conflate “Not ... both ...” and “Both ... not ...”. Compare these two sentences:

Not both Monet and Chopin are painters.

It is not the case that Monet is a painter and Chopin is a painter.

$\sim(M \cdot C)$

M: Monet is a painter.

C: Chopin is a painter.

Both Dvořák and Schubert are not painters.

Dvořák is not a painter and Schubert is not a painter.

$\sim S$

D: Dvořák is a painter.

S: Schubert is a painter.

The first sentence denies that both Monet and Chopin are painters. That is, it says that at least one of them is not a painter. It can be rephrased as

Either Monet or Chopin is not a painter.

Either Monet is not a painter or Chopin is not a painter.

$\sim C \sim C$ if we expand it fully as

Either Monet is not a painter or Chopin is not a painter.

$\sim C$.

By contrast, the second sentence is a conjunction.

Both Dvořák and Schubert are not painters.

Dvořák is not a painter and Schubert is not a painter.

$\sim S$

D: Dvořák is a painter.

S: Schubert is a painter.

Moreover, this is logically equivalent to both sentences below:

Not either Dvořák or Schubert is a painter.

It is not the case that either Dvořák is a painter or Schubert is a painter.

$\sim(D \vee S)$

Neither Dvořák nor Schubert is a painter.

It is not the case that either Dvořák is a painter or Schubert is a painter.

$\sim(D \vee S)$

$\sim S$ is logically equivalent to $\sim(D \vee S)$.

The following formulas sum up the differences between “Not ... both ...” and “Both ... not ...” and show how to symbolize them:

$\sim p \sim q =$ Not either p or $q = \sim(p \vee q) =$ Neither p nor $q = \sim(p \vee q)$

This page titled [4.3: Propositions, Inferences, and Judgments](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) ([NGE Far Press](#)) .

4.4: Validity and Soundness

21 Validity and Soundness³⁷

Sentences

Recall that a sentence is a meaningful expression that can be true or false. The sentence $\sim\sim D$ is true if and only if the sentence $\sim D$ is false, and so on through the structure of the sentence until we arrive at the atomic components:

$\sim\sim D$ is true if and only if the atomic sentence D is false.

A “well-formed formula” (wff) like $(Q \& R)$ must be surrounded by parentheses, because we might apply the definition again to use this as part of a more complicated sentence. If we negate $(Q \& R)$, we get $\sim(Q \& R)$. If we just had $Q \& R$ without the parentheses and put a negation in front of it, we would have $\sim Q \& R$. It is most natural to read this as meaning the same thing as $(\sim Q \& R)$, something very different than $\sim(Q \& R)$. The sentence $\sim(Q \& R)$ means that it is not the case that both Q and R are true; Q might be false or R might be false, but the sentence does not tell us which. The sentence $(\sim Q \& R)$ means specifically that Q is false and that R is true. As such, parentheses are crucial to the meaning of the sentence.

So, strictly speaking, $Q \& R$ without parentheses is not a sentence of SL (Sentential Logic). When using SL, however, we will often be able to relax the precise definition so as to make things easier for ourselves. We will do this in several ways.

First, we understand that $Q \& R$ means the same thing as $(Q \& R)$. As a matter of convention, we can leave off parentheses that occur around the entire sentence.

Second, it can sometimes be confusing to look at long sentences with many, nested pairs of parentheses. We adopt the convention of using square brackets '[' and ']' in place of parenthesis. There is no logical difference between $(P \vee Q)$ and $[P \vee Q]$, for example. The unwieldy sentence

$$(((H \& I) \vee (I \& H)) \& (J \vee K))$$

could be written in this way:

$$(H \& I) \vee (I \& H)$$

$$\& (J \vee K)$$

Third, we will sometimes want to translate the conjunction of three or more sentences. For the sentence ‘Alice, Bob, and Candice all went to the party’, suppose we let A mean ‘Alice went’, B mean ‘Bob went’, and C mean ‘Candice went.’ The definition only allows us to form a conjunction out of two sentences, so we can translate it as $(A \& B) \& C$ or as $A \& (B \& C)$. There is no reason to distinguish between these, since the two translations are logically equivalent. There is no logical difference between the first, in which $(A \& B)$ is conjoined with C , and the second, in which A is conjoined with $(B \& C)$. So we might as well just write $A \& B \& C$. As a matter of convention, we can leave out parentheses when we conjoin three or more sentences.

Fourth, a similar situation arises with multiple disjunctions. ‘Either Alice, Bob, or Candice went to the party’ can be translated as $(A \vee B) \vee C$ or as $A \vee (B \vee C)$. Since these two translations are logically equivalent, we may write $A \vee B \vee C$. These latter two conventions only apply to multiple conjunctions or multiple disjunctions. If a series of connectives includes both disjunctions and conjunctions, then the parentheses are essential; as with $(A \& B) \vee C$ and $A \& (B \vee C)$. The parentheses are also required if there is a series of conditionals or biconditionals (which will be covered in the next chapter); as with $(A \supset B) \supset C$ and $A \leftrightarrow (B \leftrightarrow C)$.

We have adopted these four rules as notational conventions, not as changes to the definition of a sentence. Strictly speaking, $A \vee B \vee C$ is still not a sentence. Instead, it is a kind of shorthand. We write it for the sake of convenience, but we really mean the sentence $(A \vee (B \vee C))$.

The connective that you look to first in decomposing a sentence is called the main logical operator of that sentence. For example: The main logical operator of $\sim(E \vee (F \& G))$ is negation, $\sim$. The main logical operator of $(\sim E \vee (F \& G))$ is disjunction, $\vee$.

Truth Tables

This chapter introduces a way of evaluating sentences and arguments of SL. Although it can be laborious, the truth table method is a purely mechanical procedure that requires no intuition or special insight.

Truth-functional connectives

Any non-atomic sentence of SL is composed of atomic sentences with sentential connectives. The truth-value of the compound sentence depends only on the truth-value of the atomic sentences that comprise it. In order to know the truth-value of $(D \ \& \ E)$, for instance, you only need to know the truth-value of D and the truth-value of E . Connectives that work in this way are called truth-functional.

We write the variables we are using at the top and then we generate a table where we have all of the possible combinations of True and False for the variables. For example, when we just have A , we need to know what the value of the negation is when A is true or when A is false. What this means is that the statement A has the value of being either true or false. Here's how this works: If I say that statement A is "Superman wears a cape" and this statement is true, then the negating this statement would make a new False statement "Superman does not wear a cape." However, if I say that A is "The Incredibles wear capes" and that this statement is False, then negating it would make a new True statement, "The Incredibles do not wear capes." So what this table means is that when A is True, its negation is False, and when A is False, its negation is True.

$A \ \sim A$

T F

F T

However, we hardly ever have arguments with only 1 statement. So when we have 2 statements, we need to have all of the possibilities of Truth for them. What this means (and you can see it in the table below) is that we have to make a table that shows us what the truth value of things are when A and B are both True, when A is True and B is False, when A is False and B is True, and when A and B are both False. Then we can add the connectives and see when they are true, given the assumed truth of A and B . For example, the conjunct ($\&$) is only True when they are both True and the disjunct ($\vee$) is true when at least one of them is (and only False when they are both False).

$A \ B \ A \ \& B \ A \vee B$

T T T T

T F F T

F T F T

F F F F

Now you should be able to do some analyses on some basic sentences. For the following, assume that A, B, C are True and that X, Y, Z are False. Assuming these truth values, are the following sentences True or False?

1) $\sim X \vee Y$

2) $(A \vee Z) \ \& \ B$

3) $\sim A \vee (Z \ \& \ \sim X)$

4) $(A \vee Z) \vee \sim(\sim(B \ \& \ \sim Z) \ \& \ \sim(C \vee \sim Y))$

Answers: 1) is T because $\sim X$ is True and it only takes one side of a disjunct to be True to make it all True; 2) is True; 3) is False; and 4) is True (hint: All you need to know is that A is True and it becomes really simple)

Is the following statement true?

The sky is blue or the moon is hot pink and dogs are not animals.

To figure this out, we need to symbolize it. I propose the following:

B = The sky is blue. P = The moon is hot pink. D = Dogs are animals.

$B \vee P \ \& \ \sim D$

But is it clear what this means? We need to use parentheses! But it is unclear where the parentheses go, and depending on where we put them it can be True (in the first case) or False (in the second).

$B \vee (P \ \& \ \sim D)$

$(B \vee P) \ \& \ \sim D$

Complete truth tables

The truth-value of sentences that contain only one connective is given by the characteristic truth table for that connective. To put them all in one place, the truth tables for the connectives of SL are repeated in the table.

The characteristic truth table for conjunction, for example, gives the truth conditions for any sentence of the form $(A \& B)$. Even if the conjuncts A and B are long, complicated sentences, the conjunction is true if and only if both A and B are true. Consider the sentence $(H \& I) \vee H$. We consider all the possible combinations of true and false for H and I , which gives us four rows.

We then copy the truth-values for the sentence letters and write them underneath the letters in the sentence.

$H \ I \ (H \& I) \vee H$

T T T T T

T F T F T

F T F T F

F F F F F

Now consider the subsentence $H \& I$. This is a conjunction $A \& B$ with H as A and with I as B . H and I are both true on the first row. Since a conjunction is true when both conjuncts are true, we write a T underneath the conjunction symbol. We continue for the other three rows and get this:

$H \ I \ (H \& I) \vee H$

T T T T T T

T F T F F T

F T F F T F

F F F F F F

The entire sentence is a disjunction $A \vee B$ with $(H \& I)$ as A and with H as B . On the second row, for example, $(H \& I)$ is false and H is true. Since a disjunction is true when the either disjunct is True, we write a T in the second row underneath the disjunction symbol. We continue for the other three rows and get this:

$H \ I \ (H \& I) \vee H$

T T T T T T T

T F T F F T T

F T F F T F F

F F F F F F F

The column of T s underneath the conditional tells us that the sentence $(H \& I) \vee I$ is true whenever H is true, and the truth of I doesn't determine the truth of the sentence. It is crucial that we have considered all of the possible combinations. If we only had a two-line truth table, we could not be sure that the sentence was not false for some other combination of truth-values.

Most of the columns underneath the sentence are only there for bookkeeping purposes. When you become more adept with truth tables, you will probably no longer need to copy over the columns for each of the sentence letters. In any case, the truth-value of the sentence on each row is just the column underneath the main logical operator of the sentence; in this case, the column underneath the conditional.

A complete truth table has a row for all the possible combinations of T and F for all of the sentence letters. The size of the complete truth table depends on the number of different sentence letters in the table. A sentence that contains only one sentence letter requires only two rows, as in the characteristic truth table for negation. This is true even if the same letter is repeated many times, as in the sentence $[(C \vee C) \& C] \& \sim (C \& C)$. The complete truth table requires only two lines because there are only two possibilities: C can be true or it can be false. A single sentence letter can never be marked both T and F on the same row. The truth table for this sentence looks like this:

$C \ [(C \vee C) \& C] \& \sim (C \& C)$

T T T T T T F F T T T

F F T F F F F F T F

Looking at the column underneath the main connective, we see that the sentence is false on both rows of the table; i.e., it is false regardless of whether C is true or false.

A sentence that contains two sentence letters requires four lines for a complete truth table, as in the characteristic truth tables and the table for $(H \& I) \vee I$.

A sentence that contains three sentence letters requires eight lines. For example:

$M \vee N \& P \& (N \vee P)$

T T T T T T T T

T T F T T T T F

T F T T T F T T

T F F T F F F F

F T T F F T T T

F T F F F T T F

F F T F F F T T

F F F F F F F F

From this table, we know that the sentence $M \& (N \vee P)$ might be true or false, depending on the truth-values of M, N, and P.

A complete truth table for a sentence that contains four different sentence letters requires 16 lines. Five letters, 32 lines. Six letters, 64 lines. And so on. To be perfectly general: If a complete truth table has n different sentence letters, then it must have 2^n rows.

In order to fill in the columns of a complete truth table, begin with the rightmost sentence letter and alternate Ts and Fs. In the next column to the left, write two Ts, write two Fs, and repeat. For the third sentence letter, write four Ts followed by four Fs. This yields an eight line truth table like the one above.

For a 16 line truth table, the next column of sentence letters should have eight Ts followed by eight Fs. For a 32 line table, the next column would have 16 Ts followed by 16 Fs. And so on.

Tautologies, contradictions, and contingent sentences

An English sentence is a tautology if it must be true as a matter of logic. With a complete truth table, we consider all of the ways that the world might be. If the sentence is true on every line of a complete truth table, then it is true as a matter of logic, regardless of what the world is like.

So a sentence is a tautology in SL if the column under its main connective is T on every row of a complete truth table. Conversely, a sentence is a contradiction in SL if the column under its main connective is F on every row of a complete truth table.

A sentence is contingent in SL if it is neither a tautology nor a contradiction; i.e. if it is T on at least one row and F on at least one row.

Logical equivalence

Two sentences are logically equivalent in English if they have the same truth value as a matter of logic. Once again, truth tables allow us to define an analogous concept for SL: Two sentences are logically equivalent in SL if they have the same truth-value on every row of a complete truth table. Consider the sentences $\sim(A \vee B)$ and $\sim A \& \sim B$. Are they logically equivalent? To find out, we construct a truth table.

$A \vee B \quad \sim(A \vee B) \quad \sim A \& \sim B$

T T F T T T F T F F T

T F F T T F F T F T F

F T F F T T T F F F T

F F T F F F T F T T F

Look at the columns for the main connectives; negation for the first sentence, conjunction for the second. On the first three rows, both are F. On the final row, both are T. Since they match on every row, the two sentences are logically equivalent.

Validity

An argument in English is valid if it is logically impossible for the premises to be true and for the conclusion to be false at the same time. In other words, an if the premises are true, then the conclusion must also be true. An argument is valid in SL if there is no row of a complete truth table on which the premises are all T and the conclusion is F; an argument is invalid in SL if there is such a row. Consider this argument:

$\sim L \vee (J \& L)$

L

$\therefore J$

Is it valid? To find out, we construct a truth table

.

$J \quad L \quad \sim L \vee (J \& L) \quad L \quad J$

T T F T T T T T T OK!

T F T F T T F F F T

F T F T F F F T T F

F F T F T F F F F F

Yes, the argument is valid. The only row on which both the premises are T is the first row, and on that row the conclusion is also T.

What about this one?

$\sim L \vee (J \vee L)$

L

$\therefore J$

Is it valid? To find out, we construct a truth table.

$J \quad L \quad \sim L \vee (J \vee L) \quad L \quad J$

T T F T T T T T T OK!

T F T F T T T F F T

F T F T T F T T T F Invalid!

F F T F T F F F F F

No, the argument is not valid. There are two rows where both premises are True. In one of them, the conclusion is also True. However, when J is False and L is True (row 3), the premises are True and the conclusion is False, making it invalid.

Soundness

Soundness is the easiest concept to understand, provided you understand validity. Logic is all about structure of arguments and determining validity since that's all we can do: ensure that the reasoning we are using is proper and actually takes us to the conclusions we want. Valid arguments can be wholly uninteresting, but at least their reasoning is solid. For example, this is valid:

If you eat a sandwich, then you will turn purple.

You ate a sandwich.

Therefore, you will turn purple.

It's valid...but who cares? What we *really* care about in real-life is *soundness*. An argument is sound when it is valid and all of the premises are actually true. This means you have just learned something new and real that we care about. For example,

Either you will understand this or you will re-read it.

If you re-read this, then you will understand it.

Therefore, you will understand this.

This is valid, and it is actually true, since I assume you will re-read it if you didn't catch it the first time. Here is its symbolization so you can check it for validity yourself:

$$U \vee R$$
$$R > U$$
$$\therefore U$$

This page titled [4.4: Validity and Soundness](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#).

4.5: Commons Forms of Arguments

22 Commons Forms of Arguments³⁸

Disjunctive Syllogism (DS)

The basic form disjunctive syllogism gets its name from the feature that one of the two premises is a disjunction. The disjunction tells us that at least one of its disjuncts must be true in order for the disjunction to be true. Now since the other premise asserts that one of the disjuncts is false (that is, its negation is true). It follows that the other disjunct must be true.

$p \vee q$ or $p \vee q$

$\sim p \sim q$

$\therefore q \therefore p$

Notice that in Propositional Logic, the order of the premises does not matter. So the following two are treated as the same form.

$p \vee q \sim p$

$\sim p = p \vee q$

$\therefore q \therefore q$

We can prove that the form disjunctive syllogism is valid using the truth table.

$p \ q \ p \vee q \sim p \ q$

T T T T F T T

T F T T F F T F

F T F T T T F T OK!

F F F F F T F F

After we know what the form looks like, the next step is to identify it from a written argument. Here is an example of disjunctive syllogism:

Either interest rates go up or inflation gets worse. Since interest rates have not gone up, we can be sure that inflation is getting worse.

After symbolizing the argument as

$U \vee W$

$\sim U$

$\therefore W$

we can tell that it is an instance of disjunctive syllogism. In this way we can find out that it is valid without constructing its truth table.

Recognizing Common Forms

In learning the basic argument forms, we use “p”, “q”, “r” and “s” as variables. They serve as place holders in argument forms. If we replace each variable in a basic form with a capital letter, we would of course end up with an instance of the form. But we can also replace a variable with a compound sentence. The resulting argument would also be an instance of the form. Such substitutions give us more flexibility in constructing instances of the basic forms. It also helps us identify them. Take a look at the next argument.

The current economic growth cannot be sustained unless inflation is under control. Inflation is not under control. Therefore, the current economic growth cannot be sustained.

The argument can be symbolized as

$\sim S \vee U$

$\sim U$

$\therefore \sim S$

We can then see that it is an instance of disjunctive syllogism by the following substitutions:

$p = \sim S$

$q = U$

Is the following a valid argument?

$p \vee q$ p Therefore, $\sim q$.

It is not! Think about this: You can have mustard or ketchup on your hot dog. You had mustard, therefore you didn't have ketchup. Why can't you have both? You can! Because we're using the INCLUSIVE or, remember?

I. Decide whether each of the arguments is one of the common forms. If it is, identify the name of the form and decide its validity. If it is not a common form, label it as "No Form" and use a truth table to determine its validity.

7. $B \vee C$

$\sim C$

$\therefore B$

9. $G \vee \sim N$

N

$\therefore G$

19. $C \vee \sim A$

$\sim A \vee N$

$\therefore C \vee N$

More Practice exercises

Determine whether each pair of sentences is logically equivalent.

1. $A, \sim A$

2. $A, A \vee A$

6. $\sim(A \& B), \sim A \vee \sim B$

9. $[(A \vee B) \vee C], [A \vee (B \vee C)]$

10. $[(A \vee B) \& C], [A \vee (B \& C)]$

Determine whether each argument is valid or invalid.

7. $A \vee B, B \vee C, \sim A, \therefore B \& C$

8. $A \vee B, B \vee C, \sim B, \therefore A \& C$

For the following sentences, let R mean 'You will cut the red wire' and B mean 'The bomb will explode.'

21. If you cut the red wire, then the bomb will explode.

22. The bomb will explode only if you cut the red wire.

Sentence 21 can be translated partially as 'If R, then B.' We will use the symbol ' $\supset$ ' to represent logical entailment. The sentence becomes $R \supset B$. The connective is called a conditional. The sentence on the left-hand side of the conditional (R in this example) is called the antecedent. The sentence on the right-hand side (B) is called the consequent.

Sentence 22 is also a conditional. Since the word 'if' appears in the second half of the sentence, it might be tempting to symbolize this in the same way as sentence 21. That would be a mistake. The conditional $R \supset B$ says that if R were true, then B would also be true. It does not say that your cutting the red wire is the only way that the bomb could explode. Someone else might cut the wire, or the bomb might be on a timer. The sentence $R \supset B$ does not say anything about what to expect if R is false.

Sentence 22 is different. It says that the only conditions under which the bomb will explode involve your having cut the red wire; i.e., if the bomb explodes, then you must have cut the wire. As such, sentence 22 should be symbolized as $B \supset R$.

It is important to remember that the connective ' $\supset$ ' says only that, if the antecedent is true, then the consequent is true. It says nothing about the causal connection between the two events. Translating sentence 22 as $B \supset R$ does not mean that the bomb exploding would somehow have caused your cutting the wire. Both sentence 21 and 22 suggest that, if you cut the red wire, your cutting the red wire would be the cause of the bomb exploding. They differ on the logical connection. If sentence 22 were true, then an explosion would tell us| those of us safely away from the bomb| that you had cut the red wire. Without an explosion, sentence 22 tells us nothing.

The paraphrased sentence 'A only if B' is logically equivalent to 'If A, then B.' 'If A then B' means that if A is true then so is B. So we know that if the antecedent A is true but the consequent B is false, then the conditional 'If A then B' is false. What is the truth value of 'If A then B' under other circumstances? Suppose, for instance, that the antecedent A happened to be false. 'If A then B' would then not tell us anything about the actual truth value of the consequent B, and it is unclear what the truth value of 'If A then B' would be.

In English, the truth of conditionals often depends on what would be the case if the antecedent were true| even if, as a matter of fact, the antecedent is false. This poses a problem for translating conditionals into SL. Considered as sentences of SL, R and B in the above examples have nothing intrinsic to do with each other. In order to consider what the world would be like if R were true, we would need to analyze what R says about the world. Since R is an atomic symbol of SL, however, there is no further structure to be analyzed. When we replace a sentence with a sentence letter, we consider it merely as some atomic sentence that might be true or false.

In order to translate conditionals into SL, we will not try to capture all the subtleties of the English language 'If...then...'. Instead, the symbol ' $\supset$ ' will be a material conditional. This means that when A is false, the conditional $A \supset B$ is automatically true, regardless of the truth value of B. If both A and B are true, then the conditional $A \supset B$ is true. In short, $A \supset B$ is false if and only if A is true and B is false. We can summarize this with a characteristic truth table for the conditional.

A B $A \supset B$

T T T

T F F

F T T

F F T

The conditional is asymmetrical. You cannot swap the antecedent and consequent without changing the meaning of the sentence, because $A \supset B$ and $B \supset A$ are not logically equivalent.

Interestingly, the following is logically true: If God exists, then there is evil in the world. This is because the consequent, "There is evil in the world" is True, and whenever the consequent is True, the whole conditional is True, regardless of the truth of the antecedent!

Similarly, if the antecedent is False, then the conditional is always True: If gravity makes things go up, then I am a billionaire. Since the antecedent is False, this sentence is always true! Interesting, right?

Not all sentences of the form 'If...then...' are conditionals. Consider this sentence:

23. If anyone wants to see me, then I will be on the porch.

If I say this, it means that I will be on the porch, regardless of whether anyone wants to see me or not| but if someone did want to see me, then they should look for me there. If we let P mean 'I will be on the porch,' then sentence 23 can be translated simply as P.

Biconditional

Consider these sentences:

24. The figure on the board is a triangle only if it has exactly three sides.

25. The figure on the board is a triangle if it has exactly three sides.

26. The figure on the board is a triangle if and only if it has exactly three sides.

Let T mean 'The figure is a triangle' and S mean 'The figure has three sides.'

Sentence 24, for reasons discussed above, can be translated as $T \supset S$.

Sentence 25 is importantly different. It can be paraphrased as, 'If the figure has three sides, then it is a triangle.' So it can be translated as $S \supset T$.

Sentence 26 says that T is true if and only if S is true; we can infer S from T, and we can infer T from S. This is called a biconditional, because it entails the two conditionals $S \supset T$ and $T \supset S$. We will use ' $\leftrightarrow$ ' to represent the biconditional; sentence 26 can be translated as $S \leftrightarrow T$. We could abide without a new symbol for the biconditional. Since sentence 26 means ' $T \supset S$ and $S \supset T$,' we could translate it as $(T \supset S) \& (S \supset T)$. We would need parentheses to indicate that $(T \supset S)$ and $(S \supset T)$ are separate conjuncts; the expression $T \supset S \& S \supset T$ would be ambiguous.

Because we could always write $(A \supset B) \& (B \supset A)$ instead of $A \leftrightarrow B$, we do not strictly speaking need to introduce a new symbol for the biconditional. Nevertheless, logical

languages usually have such a symbol. SL will have one, which makes it easier to translate phrases like 'if and only if.'

$A \leftrightarrow B$ is true if and only if A and B have the same truth value. This is the characteristic truth table for the biconditional:

A B $A \leftrightarrow B$

T T T

T F F

F T F

F F T

Other symbolization

We have now introduced all of the connectives of SL. We can use them together to translate many kinds of sentences. Consider these examples of sentences that use the English-language connective 'unless'~

27. Unless you wear a jacket, you will catch cold.

28. You will catch cold unless you wear a jacket.

Let J mean 'You will wear a jacket' and let D mean 'You will catch a cold.' We can paraphrase sentence 27 as 'Unless J, D.' This means that if you do not wear a jacket, then you will catch cold; with this in mind, we might translate it as $\sim J \supset D$. It also means that if you do not catch a cold, then you must have worn a jacket; with this in mind, we might translate it as $\sim D \supset J$. Which of these is the correct translation of sentence 27? Both translations are correct, because the two translations are logically equivalent in SL.

Sentence 28, in English, is logically equivalent to sentence 27. It can be translated as either $\sim J \supset D$ or $\sim D \supset J$. When symbolizing sentences like sentence 27 and sentence 28, it is easy to get turned around. Since the conditional is not symmetric, it would be wrong to translate either sentence as $J \supset \sim D$. Fortunately, there are other logically equivalent expressions. Both sentences mean that you will wear a jacket or if you do not wear a jacket then you will catch a cold. So we can translate them as $J \vee D$. (You might worry that the 'or' here should be an exclusive or. However, the sentences do not exclude the possibility that you might both wear a jacket and catch a cold; jackets do not protect you from all the possible ways that you might catch a cold.)

If a sentence can be paraphrased as 'Unless A, B,' then it can be symbolized as $A \vee B$.

The sentence 'Apples are red, or berries are blue' is a sentence of English, and the sentence ' $(A \vee B)$ ' is a sentence of SL. Although we can identify sentences of English when we encounter them, we do not have a formal definition of 'sentence of English'. In SL, it is possible to formally define what counts as a sentence. This is one respect in which a formal language like SL is more precise than a natural language like English.

If we add the conditional and the biconditional to our truth table of connectives, you can see how they function with relation to the rest of the connectives.

A B A & B $A \vee B$ $A \supset B$ $A \leftrightarrow B$

T T T T T

T F F T F F

F T F T T F

F F F F T T

Common Argument Forms⁴⁰

NOTE: $\cdot$ is $\&$ in the text below. There are different notations and in some of them they use $\cdot$ to represent conjunctions. Additionally, $\equiv$ is $\leftrightarrow$ for the same reasons.

In the previous section we learned how to use truth tables to determine whether deductive arguments are valid. As arguments get longer, their truth tables would have more rows. Using truth tables to determine their validity can become quite time-consuming. For example, the truth table of the following argument has 16 rows, and can take quite a bit of time to construct.

If interest rates are raised, the stock market will be hurt. If the stock market is hurt, the economy will slow down. But if interest rates are not raised, inflation will get worse. If inflation gets worse, the economy will slow down. So the economy will slow down.

So using truth tables to determine validity can be tedious, and there is an incentive to find a more efficient way.

Arguments such as this are built by combining small and basic valid argument forms. This means that if we can recognize the small forms and see how they are put together to form longer arguments, then we can determine validity without constructing truth tables.

Basic Valid Forms

There are six basic forms that are commonly used:

1. Disjunctive Syllogism (DS) (covered in the last chapter)
2. Hypothetical Syllogism (HS)
3. Modus Ponens (MP)
4. Modus Tollens (MT)
5. Constructive Dilemma (CD)
6. Destructive Dilemma (DD)

We are going to study them and learn how to recognize them.

Hypothetical Syllogism (HS)

A hypothetical syllogism has a distinct feature that helps us recognize it. The argument consists of three conditionals. The first conditional says that p is a sufficient condition for q . The second one says that q in turn is a sufficient condition for r . It would then follow that p is a sufficient condition for r .

$p \supset q$

$q \supset r$

$\therefore p \supset r$

Example:

If more prisons are built, public education will get worse due to lack of funding. If public education gets worse due to lack of funding, there will be more criminals. As a result, if more prisons are built, there will be more criminals.

has the form

$B \supset W$

$W \supset C$

$\therefore B \supset C$

and thus is an instance of hypothetical syllogism.

Modus Ponens (MP)

“Modus Ponens” is the Latin term for “Affirmative Mode.” We can also call it “Affirming the

Antecedent” because one of its premises affirms that the antecedent of the conditional is true. It is a valid form based on the concept of sufficient condition. If p is a sufficient condition of q , and p is true, then q must be true.

$$p \supset q$$
$$p$$
$$\therefore q$$

Modus Ponens is one of the most commonly used valid forms. Here is an example:

If Republicans favor free market economy, then they should oppose farm subsidies. Republicans favor free market economy. So they should oppose farm subsidies.

The argument is symbolized as

$$F \supset O$$
$$F$$
$$\therefore O$$

We can see that its form is Modus Ponens and thus is valid.

Modus Tollens (MT)

“Modus Tollens” means “Denying Mode” in Latin. Its English name is “Denying the Consequent”

because one of its premises denies that the consequent of the conditional is true. The validity of Modus Tollens can be easily explained using the concept of necessary condition. If q is a necessary condition of p , and q is false, then p must be false.

$$p \supset q$$
$$\sim q$$
$$\therefore \sim p$$

The next argument is an example of Modus Tollens:

We should be against big corporations only if we are against their stock holders. We are not against the stock holders. So we should not be against big corporations.

$$B \supset S$$
$$\sim S$$
$$\therefore \sim B$$

Constructive Dilemma (CD)

Constructive dilemma, like Modus Ponens, is built upon the concept of sufficient condition. The

two conditionals $p \supset q$ and $r \supset s$ can be joined together as a conjunction or stated separately as two premises. They assert that p is a sufficient condition for q and r is a sufficient condition for s .

Consequently, if at least one of the sufficient conditions is true, then at least one of the consequents must also be true.

$$(p \supset q) \cdot (r \supset s) \text{ or } p \supset q$$
$$p \vee r \text{ or } r \supset s$$
$$\therefore q \vee s \text{ or } p \vee r$$
$$\therefore q \vee s$$

After symbolizing the argument

If consumers increase spending, then inflation will get worse. If consumers cut back on spending, then there will be a recession. Consumers either increase or cut back on spending. It follows that the inflation will get worse or there will be a recession.

as

$$(I \supset W) \cdot (C \supset R)$$
$$I \vee C$$
$$\therefore W \vee R$$

We can see that it is a constructive dilemma, and thus is valid.

$\sim p$ as one of the premises.

$$(p \supset q) \cdot (\sim p \supset s)$$

$$p \vee \sim p$$

$$\therefore q \vee s$$

$\sim p$ is a tautology, the argument is sound if the premise $(p \supset q) \cdot (\sim p \supset s)$ is true. Here is an example of this commonly seen version of constructive dilemma:

With protectionism, prices for consumer goods would become higher. Without protectionism, jobs would be lost. Since we either adopt protectionism or reject it, prices for consumer goods would become higher or jobs would be lost.

$$(P \supset H) \cdot (\sim P \supset J)$$

$$P \vee \sim P$$

$$\therefore H \vee J$$

Destructive Dilemma (DD)

Destructive dilemma is another common form based on the concept of necessary condition. The two conditionals assert that q is a necessary condition for p and s is a necessary condition for r . So if q is false or s is false, then it must be the case that p is false or r is false.

$$(p \supset q) \cdot (r \supset s) \text{ or } p \supset q$$

$$\sim s \text{ or } \sim s$$

$$\sim p \vee \sim r \vee \sim q \vee \sim s$$

$$\sim r$$

Here is an example of destructive dilemma:

Global warming can be slowed down only if we switch to cleaner energy sources. But the current level of industrial production can be sustained only if we continue to use fossil fuels. We won't switch to cleaner energy sources or we won't continue to use fossil fuels. As a result, global warming cannot be slowed down or the current level of industrial production cannot be sustained.

$$(G \supset S) \cdot (P \supset F)$$

$$\sim S \vee \sim F$$

$$\therefore \sim G \vee \sim P$$

It is also common to see a destructive dilemma with a tautologous disjunction as one of its premises:

$$\sim q)$$

$$q \vee \sim q$$

$$\sim r$$

$\sim q$). The following argument is an instance of such a form:

GM can be competitive only if it increases outsourcing. UAW workers can have job security only if GM does not increase outsourcing. GM either increases or does not increase outsourcing. Therefore, either GM cannot be more competitive or UAW workers cannot have job security.

$$\sim I) \sim I$$

$$\therefore \sim C \vee \sim J$$

The Problem of Evil — a Destructive Dilemma

There is a well-known philosophical problem called the problem of evil in western philosophy and religions. It argues that God is either not all-powerful or not all-good. The argument can be constructed as a destructive dilemma:

1. If God is all-powerful (P), He would be able to eliminate evil (A).

2. If God is all-good (G), He would want to eliminate evil (W).
3. Evil exists. (This means that God is not able to eliminate evil, or God does not want to eliminate evil.)
4. Therefore, God is either not all-powerful or not all-good.

After symbolization,

$$(P \supset A) \cdot (G \supset W)$$

$$\sim A \vee \sim W$$

$$\sim G$$

we can see that the argument indeed is an instance of destructive dilemma.

Recognizing Common Forms

In learning the basic argument forms, we use “p”, “q”, “r” and “s” as variables. They serve as place holders in argument forms. If we replace each variable in a basic form with a capital letter, we would of course end up with an instance of the form. But we can also replace a variable with a compound sentence. The resulting argument would also be an instance of the form. Such substitutions give us more flexibility in constructing instances of the basic forms. It also helps us identify them.

In the next example, we should recognize $A \cdot K$ as the antecedent p and $\sim D$ as the consequent q. As a result, it is a Modus Ponens.

$$(A \cdot K) \supset \sim D$$

$$(A \cdot K)$$

$$\therefore \sim D$$

To properly identify the next form as an instance of disjunctive syllogism, we need to apply the rule of double negation, which says that p is logically equivalent to $\sim \sim p$. Afterwards, we substitute p for $G \supset M$ and q for $\sim D$.

$$(G \supset M) \vee \sim D$$

$$D$$

$$\therefore G \supset M$$

Combining Basic Forms

We can combine basic argument forms to construct longer and more complex arguments. The argument

If interest rates are raised, the stock market will be hurt. If the stock market is hurt, the economy will slow down. But if interest rates are not raised, inflation will get worse. If inflation gets worse, the economy will slow down. So the economy will slow down.

is built by combining two hypothetical syllogisms with a constructive dilemma. It is easier to see the logical structure from the symbolization.

$$R \supset S$$

$$S \supset E$$

$$\sim R \supset W$$

$$W \supset E$$

$$(R \vee \sim R)$$

$$\therefore E$$

$\sim R$ as the last premise. The tautology goes unstated in the original argument because it is trivial that it is true. Now from the first two premises, we can derive $R \supset E$ as a conclusion based on hypothetical syllogism.

$$R \supset S$$

$$S \supset E$$

$$\therefore R \supset E$$

Using hypothetical syllogism one more time, we can draw the conclusion $\sim R \supset E$ from the third and the fourth premises.

$$\sim R \supset W$$
$$W \supset E$$
$$\therefore \sim R \supset E$$

$\sim R$, we arrive at the conclusion E according to constructive dilemma.

$$R \supset E$$
$$\sim R \supset E$$
$$R \vee \sim R$$
$$\therefore E$$

Using Basic Forms to Determine Validity

As we saw above, the argument is constructed by combining three basic forms. Since each of them is valid, we can determine that it is valid without constructing a long truth table with 16 rows. Since long arguments are often constructed out of basic forms, we can determine their validity by identifying the basic forms. If all of the basic forms are valid, then the long argument is valid. But if one of the basic forms is invalid, then the long argument is invalid. This is not a rigorous formal process like the truth table method. But it does enable us to determine validity without constructing truth tables. When we try to break up a long argument into basic forms, we need to, when possible, identify valid forms first. To decide the validity of the argument,

A new game console is in high demand only if there are a lot of exciting games available for it. However, many game developing companies won't design new games for a new console unless it is in high demand. Since there are not a lot of exciting games available for a new console, it follows that many game developing companies won't design new games for it.

we first symbolize it as

$$H \supset E$$
$$\sim D \vee H$$
$$\sim E$$
$$\therefore \sim D$$

Then we break it apart into the following two forms:

$$H \supset E \text{ and } \sim D \vee H$$
$$\sim E \sim H$$
$$\therefore \sim H \therefore \sim D$$

Modus Tollens Disjunctive Syllogism

In the next example,

If we continue the acceleration of production and consumption, we will deplete natural resources within one hundred years. If natural resources are depleted within one hundred years, life on earth will not be sustainable. We continue to accelerate production and consumption. As a result, life on earth will not be sustainable.

the argument is symbolized as

$$C \supset D$$
$$\sim S$$
$$C$$
$$\therefore \sim S$$

We can see that it is constructed from the following two valid forms, and thus is valid.

$$\sim S$$
$$D \supset \sim S \text{ C}$$
$$\sim S \therefore \sim S$$

Hypothetical Syllogism Modus Ponens

The next argument

If one is a fiscal conservative, then one would be against big government spending. But if one is against big government spending, then one would support budget cut on military spending. President Bush supports budget cut on military spending. Therefore, he is a fiscal conservative.

$F \supset A$

$A \supset S$

S

$\therefore F$

is invalid because after we separate it into two forms:

$F \supset A$ and $F \supset S$

$A \supset S$

$\therefore F \supset S \therefore F$

Hypothetical Syllogism Affirming the Consequent

we find that the second form is invalid.

Exercises

I. Decide whether each of the arguments is one of the common forms. If it is, identify the name of the form and decide its validity. If it is not a common form, label it as “No Form”.

1. $A \supset C$

A

$\therefore C$

2. $H \supset K$

$\sim H$

$\therefore \sim K$

3. $E \supset G$

$\sim G$

$\therefore \sim E$

4. $\sim S \supset M$

$\sim M$

$\therefore S$

$\sim D$

R

$\therefore \sim D$

$\sim P$

P

$\therefore F$

$\sim L$

$\sim L$

$\therefore A$

$$10. K \supset M$$

$$\sim M \supset E$$

$$\therefore K \supset E$$

$$11. \sim D \supset E$$

$$P \supset \sim D$$

$$\therefore P \supset E$$

$$\sim V) \cdot (\sim A \supset U)$$

$$V \vee \sim U$$

$$\therefore \sim S \vee A$$

$$\sim F$$

$$\sim F$$

$$\therefore C$$

$$14. (R \supset L) \cdot (\sim R \supset E)$$

$$R \vee \sim R$$

$$\therefore L \vee E$$

$$\sim (H \equiv N)$$

$$H \equiv N$$

$$\therefore \sim G$$

$$16. (A \cdot \sim B) \supset K$$

$$\sim B)$$

$$\therefore \sim K$$

$$\sim D)$$

$$\sim J \vee \sim P$$

$$\therefore \sim M \vee D$$

$$18. F \supset (\sim D \vee E)$$

$$\sim (\sim D \vee E)$$

$$\therefore \sim F$$

$$\sim S$$

$$\sim S \supset T$$

$$\therefore \sim (R \cdot C) \supset T$$

II. Use the common argument forms to derive the conclusion from the premises.

$$1. \sim A \supset E$$

$$\sim E$$

$$2. D \supset H$$

$$\sim D$$

$$3. C \supset R$$

$$R$$

$$4. K \supset B$$

$$B \supset R$$

$\sim N$

$\sim G$

6. $(K \cdot A) \supset M$

M

$\sim L$

L

8. $\sim B \supset R$

$\sim S$

$\sim B \vee D$

$\sim D$

D

10. $A \vee (C \supset U)$

$\sim(C \supset U)$

$\sim H) \supset N$

$P \supset \sim H$

$\sim R)$

$A \vee R$

$\sim E$

$\sim E \supset \sim P$

14. $(J \vee D) \supset Q$

$J \vee D$

$\sim N)$

$\sim K$

16. $\sim B \supset F$

$\sim L)$

$\sim F \vee \sim(N \vee \sim L)$

This page titled [4.5: Commons Forms of Arguments](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

4.6: Formal Fallacies

23 Formal Fallacies⁴¹

Affirming the consequent

1. If A is true, then B is true.
2. B is true.
3. Therefore, A is true.

Even if the premise and conclusion are all true, the conclusion is not a necessary consequence of the premise. This sort of *non sequitur* is also called affirming the consequent.

An example of affirming the consequent would be:

1. If Jackson is a human (A), then Jackson is a mammal. (B)
2. Jackson is a mammal. (B)
3. Therefore, Jackson is a human. (A)

While the conclusion may be true, it does not follow from the premise:

1. Humans are mammals
2. Jackson is a mammal
3. Therefore, Jackson is a human

The truth of the conclusion is independent of the truth of its premise – it is a 'non sequitur', since Jackson might be a mammal without being human. He might be an elephant.

Affirming the consequent is essentially the same as the fallacy of the undistributed middle, but using propositions rather than set membership.

Denying the antecedent

Another common *non sequitur* is this:

1. If A is true, then B is true.
2. A is false.
3. Therefore, B is false.

While B can indeed be false, this cannot be linked to the premise since the statement is a *non sequitur*. This is called denying the antecedent.

An example of denying the antecedent would be:

1. If I am Japanese, then I am Asian.
2. I am not Japanese.
3. Therefore, I am not Asian.

While the conclusion may be true, it does not follow from the premise. For all the reader knows, the statement's declarant could be another ethnicity of Asia, e.g. Chinese, in which case the premise would be true but the conclusion false. This argument is still a fallacy even if the conclusion is true.

Affirming a disjunct

Affirming a disjunct is a fallacy when in the following form:

1. A is true or B is true.
2. B is true.
3. Therefore, A is not true.*

The conclusion does not follow from the premise as it could be the case that A and B are both true. This fallacy stems from the stated definition of *or* in propositional logic to be inclusive.

An example of affirming a disjunct would be:

1. I am at home or I am in the city.
2. I am at home.
3. Therefore, I am not in the city.

While the conclusion may be true, it does not follow from the premise. For all the reader knows, the declarant of the statement very well could be in both the city and their home, in which case the premises would be true but the conclusion false. This argument is still a fallacy even if the conclusion is true.

*Note that this is only a logical fallacy when the word "or" is in its inclusive form. If the two possibilities in question are mutually exclusive, this is not a logical fallacy. For example,

1. I am either at home or I am in the city.
2. I am at home.
3. Therefore, I am not in the city.

Denying a conjunct

Denying a conjunct is a fallacy when in the following form:

1. It is not the case that both A is true and B is true.
2. B is not true.
3. Therefore, A is true.

The conclusion does not follow from the premise as it could be the case that A and B are both false.

An example of denying a conjunct would be:

1. I cannot be both at home and in the city.
2. I am not at home.
3. Therefore, I am in the city.

While the conclusion may be true, it does not follow from the premise. For all the reader knows, the declarant of the statement very well could neither be at home nor in the city, in which case the premise would be true but the conclusion false. This argument is still a fallacy even if the conclusion is true.

Fallacy of the undistributed middle

The fallacy of the undistributed middle takes the following form:

1. All Zs are Bs.
2. Y is a B.
3. Therefore, Y is a Z.

It may or may not be the case that "all Zs are Bs", but in either case it is irrelevant to the conclusion. What is relevant to the conclusion is whether it is true that "all Bs are Zs," which is ignored in the argument.

An example can be given as follows, where B=mammals, Y=Mary and Z=humans:

1. All humans are mammals.
2. Mary is a mammal.
3. Therefore, Mary is a human.

Note that if the terms (Z and B) were swapped around in the first co-premise then it would no longer be a fallacy and would be correct.

This page titled [4.6: Formal Fallacies](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

4.7: Formalizing your Arguments

24 Formalizing your Arguments⁴²

Now it's time for you to apply all of your formal logical skills. It is good practice to look at arguments you see in a formal, deductive fashion whenever possible because it allows you to see if the reasoning employed is valid or falls afoul of a fallacy. It also shows you exactly where and how the argument goes wrong. If it is valid, then the next step is checking it for soundness (at the premises actually true?) Illustrating the truth of premises usually falls on the shoulders of inductive logic, which is covered in the next chapter.

What you should do now is try and formalize an argument in your own writings. Do the following:

1) Identify your conclusion. 2) Identify your premises. 3) Break down your premises into the smallest units you can and symbolize each claim. 4) Symbolize each logical statement you make in your argument. 5) Structure the argument in a formal fashion to make the flow of your statements lead naturally to your conclusion. 6) Check it for validity and note any standard forms your argument employs, citing them to show its validity. 7) Check to see if any of your claims are not needed to draw your conclusions from your premises. If so, remove those claims.

For example, if I were to argue,

LED lights are very cost efficient. They can also produce a range of natural-looking light. They didn't use to look so natural, but they do now. Regular lights are cheaper, but they don't last as long. LED lights use less energy than other light sources. Therefore, you should buy LED lights instead of other light options.

1) Conclusion: You should buy LED lights instead of other light options. (B) 2) Premise 1: LED lights are very cost efficient. (C)

Premise 2: LEDs can also produce a range of natural-looking light. (N)

Premise 3: LEDs didn't use to look so natural, but they do now.

Premise 4: Regular lights are cheaper, but they don't last as long.

Premise 5: LED lights use less energy than other light sources. (E)

3) Premise 3a: LEDs didn't use to look so natural. ($\sim P$)

Premise 3b: LEDs look natural now. (L)

Premise 4a: Regular lights are cheaper than LEDs. (R)

Premise 4b: Regular lights don't last as long as LEDs. ($\sim T$)

4) See parentheses above 5) C

N

$\sim P$

L

R

$\sim T$

E

$\therefore B$

6) This argument is not valid at all and is just a bunch of statements. To make it cleaner, I should try to do something like the following:

$\sim T$

E

$(\sim T \& E) \supset C$

N

$(C \& N) \supset B$

∴B

Now it uses two *modus ponens* and some conjunctions to reach the conclusion. Doing it this way also tells me I can clean up how I write my argument to be:

Regular lights don't last as long as LEDs. LED lights use less energy than other light sources. If LEDs last longer than other light sources and they use less energy, then they are more cost efficient. LEDs produce natural-looking light. If LEDs produce natural-looking light and are more cost efficient, then you should buy LEDs instead of other light options. Therefore, you should buy LEDs instead of other light options.

7) I already did this in 6 and eliminated a number of claims ($\sim P$, R, etc.) that didn't matter when what I'm concerned with doing is making a valid argument to reach my conclusion. However, there are still problems in how I have phrased my argument that get in the way of it being as strong as it could be. Can you see how I can word it better to make it stronger?

This page titled [4.7: Formalizing your Arguments](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

CHAPTER OVERVIEW

5: Inductive Arguments

Unlike deductive arguments, inductive reasoning allows for the possibility that the conclusion is false, even if all of the premises are true. Instead of being valid or invalid, inductive arguments are either *strong* or *weak*, which describes how *probable* it is that the conclusion is true. Another crucial difference is that deductive certainty is impossible in non-axiomatic systems, such as reality, leaving inductive reasoning as the primary route to (probabilistic) knowledge of such systems.

[5.1: Prelude to Inductive Arguments](#)

[5.2: Cogency and Strong Arguments](#)

[5.3: Causality and Scientific Reasoning](#)

[5.4: Analogy](#)

[5.5: Statistical Reasoning- Bayes' Theorem](#)

[5.6: Legal Reasoning and Moral Reasoning](#)

[5.7: Editing Your Final Essay](#)

This page titled [5: Inductive Arguments](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

5.1: Prelude to Inductive Arguments

43

Unlike deductive arguments, inductive reasoning allows for the possibility that the conclusion is false, even if all of the premises are true. Instead of being valid or invalid, inductive arguments are either *strong* or *weak*, which describes how *probable* it is that the conclusion is true. Another crucial difference is that deductive certainty is impossible in non-axiomatic systems, such as reality, leaving inductive reasoning as the primary route to (probabilistic) knowledge of such systems.

Given that "if *A* is true then that would cause *B*, *C*, and *D* to be true", an example of deduction would be "*A* is true therefore we can deduce that *B*, *C*, and *D* are true". An example of induction would be "*B*, *C*, and *D* are observed to be true therefore *A* might be true". *A* is a reasonable explanation for *B*, *C*, and *D* being true.

For example:

A large enough asteroid impact would create a very large crater and cause a severe impact winter that could drive the non-avian dinosaurs to extinction.

We observe that there is a very large crater in the Gulf of Mexico dating to very near the time of the extinction of the non-avian dinosaurs

Therefore it is possible that this impact could explain why the non-avian dinosaurs became extinct.

Note however that this is not necessarily the case. Other events also coincide with the extinction of the non-avian dinosaurs. For example, the Deccan Traps in India.

A classical example of an *incorrect* inductive argument was presented by John Vickers:

All of the swans we have seen are white.

Therefore, we know that all swans are white.

The correct conclusion would be, "We expect that all swans are white".

The definition of *inductive* reasoning described in this article excludes mathematical induction, which is a form of *deductive* reasoning that is used to strictly prove properties of recursively defined sets. The deductive nature of mathematical induction is based on the non-finite number of cases involved when using mathematical induction, in contrast with the finite number of cases involved in an enumerative induction procedure with a finite number of cases like proof by exhaustion. Both mathematical induction and proof by exhaustion are examples of complete induction. Complete induction is a type of masked deductive reasoning.

An argument is deductive when the conclusion is necessary given the premises. That is, the conclusion cannot be false if the premises are true.

If a deductive conclusion follows duly from its premises it is valid; otherwise it is invalid (that an argument is invalid is not to say it is false. It may have a true conclusion, just not on account of the premises). An examination of the above examples will show that the relationship between premises and conclusion is such that the truth of the conclusion is already implicit in the premises. Bachelors are unmarried because we say they are; we have defined them so. Socrates is mortal because we have included him in a set of beings that are mortal.

For inductive reasoning the premises or prior data provide support for the conclusion, but they do not guarantee it. The result is a conclusion having, it is often said, a "degree of certainty." The phrase is not optimal since certainty is absolute and does not come in degrees; what is really meant is degrees approaching certainty. Succinctly put: deduction is about certainty/necessity; induction is about *probability*. This is the best way to understand and remember the difference between inductive vs. deductive reasoning. Any single assertion will answer to one of these two criteria. (There is also modal logic, which deals with the distinction between the necessary and the *possible* in a way not concerned with probabilities among things deemed possible.)

Inductive reasoning (as opposed to *deductive* reasoning or *abductive* reasoning) is a method of reasoning in which the premises are viewed as supplying some evidence for the truth of the conclusion. While the conclusion of a deductive argument is certain, the truth of the conclusion of an inductive argument may be *probable*, based upon the evidence given.

The philosophical definition of inductive reasoning is more nuanced than simple progression from particular/individual instances to broader generalizations. Rather, the premises of an inductive logical argument indicate some degree of support (inductive probability) for the conclusion but do not entail it; that is, they suggest truth but do not ensure it. In this manner, there is the possibility of moving from general statements to individual instances (for example, statistical syllogisms, discussed below).

5.1: Prelude to Inductive Arguments is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by LibreTexts.

5.2: Cogency and Strong Arguments

Strength and Weakness

Inductive arguments are said to be either strong or weak. There's no absolute cut-off between strength and weakness, but some arguments will be very strong and others very weak, so the distinction is still useful even if it is not precise. A strong argument is one where, if the premises were true, the conclusion would be very likely to be true. A weak argument is one where the conclusion does not follow from the premises (i.e. even if the premises were true, there would still be a good chance that the conclusion could be false.)

Most arguments in courts of law attempt to be strong arguments; they are generally not attempts at valid arguments.

So, the following example is a strong argument.

John was found with a gun in his hand, running from the apartment where Tom's body was found. Three witnesses heard a gunshot right before they saw John run out. The gun in John's possession matched the ballistics on the bullet pulled from Tom's head. John had written a series of threatening letters to Tom. In prison, John confessed to his cellmate that he had killed Tom. Therefore, John is the murder of Tom.

Given that all the premises were true, it would be very likely that the conclusion would be true.

Importantly, strength has nothing to do with the actual truth of the premises!

This is something people frequently forget, so it's worth repeating: A STRONG ARGUMENT NEEDN'T HAVE ANY TRUE PREMISES! ALL THE PREMISES OF A STRONG ARGUMENT CAN BE FALSE!

The argument is strong because: if the premises WERE true, the conclusion would be likely to be true.

So the following arguments are strong:

98% of Dominicans have superpowers. Lucy is Dominican. I saw Lucy leap from the top of a tall building last week and walk away unscathed. Lucy has superpowers.

People from the lost continent of Atlantis have been manipulating the world's governments for years by placing Atlantean wizards in positions of power. Whenever possible, they place an Atlantean wizard in the executive position of the most powerful government on earth. They did this in the Roman empire, the Mongol empire, and the British empire. Currently, the United States is the most powerful country on earth. Barack Obama was born in Hawai'i, where about 45% of the people are actually Atlanteans. While he was a Senator from Illinois, he received over 10 billion dollars in funds from a mysterious holding company called "Atlantis Incorporated." Several journalists claim that they have seen Barack Obama perform feats of magic. For example, Shep Smith of Fox News said he saw Barack Obama walk on water. Barack Obama is clearly an Atlantean wizard.

Two leading researchers in genetics have found that, in every sample of DNA they looked at, there were traces of kryptonite. They examined 1600 samples, from 1600 separate individuals, including an equal distribution from all continents. The results were then replicated in another, larger study of 2700 samples, also taken from all continents. We conclude, then, that normal DNA contains kryptonite.

Cogency: If an argument is strong and all its premises are true, the argument is said to be cogent.

The following arguments are weak. The premises provide little, if any, evidence for the conclusions:

I saw your boyfriend last night and he was talking to another girl. So he's cheating on you.

Senator Bonham served 8 years in military, whereas his opponent, Mr. Malham never served one day of military service. So you should vote for Senator Bonham.

More people buy Juff™ brand peanut butter than any other brand, so you should buy Juff™!

It's notable, again, that the truth of the premises is irrelevant. A weak argument can have true premises and a true conclusion. What makes it weak is that the premises do not provide good reason to believe the conclusion.

Induction⁴⁵

All of the argument forms we have looked at so far have been deductively valid. That meant, we said, that the conclusion follows from necessity if the premises are true. But to what extent can we ever be sure of the truth of those premises? Inductive

argumentation is a less certain, more realistic, more familiar way of reasoning that we all do, all the time. Inductive argumentation recognizes, for instance, that a premise like “All horses have four legs” comes from our previous experience of horses. If one day we were to encounter a three-legged horse, deductive logic would tell us that “All horses have four legs” is false, at which point the premise becomes rather useless for a deducer. In fact, deductive logic tells us that if the premise “All horses have four legs” is false, even if we know there are many, many four-legged horses in the world, when we go to the track and see hordes of four-legged horses, all we can really be certain of is that “There is at least one four-legged horse.”

Inductive logic allows for the more realistic premise, “The vast majority of horses have four legs”. And inductive logic can use this premise to infer other useful information, like “If I’m going to get Chestnut booties for Christmas, I should probably get four of them.” The trick is to recognize a certain amount of uncertainty in the truth of the conclusion, something for which deductive logic does not allow. In real life, however, inductive logic is used much more frequently and (hopefully) with some success. Let’s take a look at some of the uses of inductive reasoning.

Predicting the Future

We constantly use inductive reasoning to predict the future. We do this by compiling evidence based on past observations, and by assuming that the future will resemble the past. For instance, I make the observation that every other time I have gone to sleep at night, I have woken up in the morning. There is actually no certainty that this will happen, but I make the inference because of the fact that this is what has happened every other time. In fact, it is not the case that “All people who go to sleep at night wake up in the morning”. But I’m not going to lose any sleep over that. And we do the same thing when our experience has been less consistent. For instance, I might make the assumption that, if there’s someone at the door, the dog will bark. But it’s not outside the realm of possibility that the dog is asleep, has gone out for a walk, or has been persuaded not to bark by a clever intruder with sedative-laced bacon. I make the assumption that if there’s someone at the door, the dog will bark, because that is what usually happens.

Explaining Common Occurrences

We also use inductive reasoning to explain things that commonly happen. For instance, if I’m about to start an exam and notice that Bill is not here, I might explain this to myself with the reason that Bill is stuck in traffic. I might base this on the reasoning that being stuck in traffic is a common excuse for being late, or because I know that Bill never accounts for traffic when he’s estimating how long it will take him to get somewhere. Again, that Bill is actually stuck in traffic is not certain, but I have some good reasons to think it’s probable. We use this kind of reasoning to explain past events as well. For instance, if I read somewhere that 1986 was a particularly good year for tomatoes, I assume that 1986 also had some ideal combination of rainfall, sun, and consistently warm temperatures. Although it’s possible that a scientific madman circled the globe planting tomatoes wherever he could in 1986, inductive reasoning would tell me that the former, environmental explanation is more likely. (But I could be wrong.)

Generalizing

Often we would like to make general claims, but in fact it would be very difficult to prove any general claim with any certainty. The only way to do so would be to observe every single case of something about which we wanted to make an observation. This would be, in fact, the only way to prove such assertions as, “All swans are white”. Without being able to observe every single swan in the universe, I can never make that claim with certainty. Inductive logic, on the other hand, allows us to make the claim, with a certain amount of modesty.

Inductive Generalization

Inductive generalization allows us to make general claims, despite being unable to actually observe every single member of a class in order to make a certainly true general statement. We see this in scientific studies, population surveys, and in our own everyday reasoning. Take for example a drug study. Some doctor or other wants to know how many people will go blind if they take a certain amount of some drug for so many years. If they determine that 5% of people in the study go blind, they then assume that 5% of all people who take the drug for that many years will go blind. Likewise, if I survey a random group of people and ask them what their favourite colour is, and 75% of them say “purple”, then I assume that purple is the favourite colour of 75% of people. But we have to be careful when we make an inductive generalization. When you tell me that 75% of people really like purple, I’m going to want to know whether you took that survey outside a Justin Bieber concert.

Let’s take an example. Let’s say I asked a class of 400 students whether or not they think logic is a valuable course, and 90% of them said yes. I can make an inductive argument like this:

(P1) 90% of 400 students believe that logic is a valuable course.

(C) Therefore 90% of students believe that logic is a valuable course.

There are certain things I need to take into account in judging the quality of this argument. For instance, did I ask this in a logic course? Did the respondents have to raise their hands so that the professor could see them, or was the survey taken anonymously? Are there enough students in the course to justify using them as a representative group for students in general?

If I did, in fact, make a class of 400 logic students raise their hands in response to the question of whether logic is valuable course, then we can identify a couple of problems with this argument. The first is bias. We can assume that anyone enrolled in a logic course is more likely to see it as valuable than any random student. I have therefore skewed the argument in favour of logic courses. I can also question whether the students were answering the question honestly. Perhaps if they are trying to save the professor's feelings, they are more likely to raise their hands and assure her that the logic course is a valuable one.

Now let's say I've avoided those problems. I have assured that the 400 students I have asked are randomly selected, say, by soliciting email responses from randomly selected students from the university's entire student population. Then the argument looks stronger.

Another problem we might have with the argument is whether I have asked enough students so that the whole population is well-represented. If the student body as a whole consists of 400 students, my argument is very strong. If the student body numbers in the tens of thousands, I might want to ask a few more before assuming that the opinions of a few mirror those of the many. This would be a problem with my sample size.

Let's take another example. Now I'm going to run a scientific study, in which I will pay someone \$50 to take a drug with unknown effects and see if it makes them blind. In order to control for other variables, I open the study only to white males between the ages of 18 and 25.

A bad inductive argument would say:

(P1) 40% of 1000 people who took the drug went blind.

(C) Therefore 40% of people who take the drug will go blind.

A better inductive argument would make a more modest claim:

(P1) 40% of the 1000 people who took the drug went blind.

(C) Therefore 40% of white males between the ages of 18 and 25 who take the drug will go blind.

The point behind this example is to show how inductive reasoning imposes an important limitation on the possible conclusions a study or a survey can make. In order to make good generalizations, we need to ensure that our sample is representative, non-biased, and sufficiently sized.

Statistical Syllogism

Where in an inductive generalization we saw statement expressing a statistic applied to a more general group, we can also use statistics to go from the general to the particular. For instance, if I know that most computer science majors are male, and that some random individual with the androgynous name "Cameron" is an computer science major, then we can be reasonably certain that Cameron is a male. We tend to represent the uncertainty by qualifying the conclusion with the word "probably". If, on the other hand, we wanted to say that something is unlikely, like that Cameron were a female, we could use "probably not". It is also possible to temper our conclusion with other similar qualifying words.

Let's take an example.

(P1) Of the 133 people found guilty of homicide last year in Canada, 79% were jailed.

(P2) Socrates was found guilty of homicide last year in Canada.

(C) Therefore, Socrates was probably jailed.

In this case we can be reasonably sure that Socrates is currently rotting in prison. Now the certainty of our conclusion seems to be dependent on the statistics we're dealing with. There are definitely more certain and more uncertain cases.

(P1) In the last election, 50% of voting Americans voted for Obama, while 48% voted for Romney.

(P2) Jim is a voting American.

(C) Therefore, Jim probably voted for Obama.

Clearly, this argument is not as strong as the first. It is only slightly more likely than not that Jim voted for Obama. In this case we might want to revise our conclusion to say:

(C) Therefore, it is slightly more likely than not that Jim voted for Obama.

In other cases, the likelihood that something is or is not the case approaches certainty. For example:

(P1) There is a 0.00000059% chance you will die on any single flight, assuming you use one of the most poorly rated airlines.

(P2) I'm flying to Paris next week.

(C) There's more than a million to one chance that I will die on my flight.

Note that in all of these examples, nothing is ever stated with absolute certainty. It is possible to improve the chances that our conclusions will be accurate by being more specific, or finding out more information. We would know more about Jim's voting strategy, for instance, if we knew where he lived, his previous voting habits, or if we simply asked him for whom he voted (in which case, we might also want to know how often Jim lies).

Induction by Shared Properties

Induction by shared properties involves noting the similarity between two things with respect to their properties, and inferring from this that they may share other properties.

A familiar example of this is how a company might recommend products to you based on other customers' purchases. Amazon.com tells me, for instance, that customers who bought the complete Sex and the City DVD series also bought Lipstick Jungle and Twilight.

Assuming that people buy things because they like them, we can rephrase this as:

(P1) There are a large number of people who, if they like Sex and the City and Twilight, will also like Lipstick Jungle.

I could also make the following observation:

(P2) I like Sex and the City and Twilight.

And then infer from there two premises that:

(C) I would also like Lipstick Jungle.

And I did. In general, induction by shared properties assumes that if something has properties w, x, y, and z, and if something else has properties w, x, and y, then it's reasonable to assume that that something else also has property z. Note that in the above example all of the properties were actually preferences with regard to entertainment. The kinds of properties involved in the comparison can and will make an argument better or worse. Let's consider a worse induction.

(P1) Lisa is tall, has blonde hair, has blue eyes, and rocks out to Nirvana on weekends.

(P2) Gina is tall, has blonde hair, and has blue eyes.

(C) Therefore Gina probably rocks out to Nirvana on weekends.

In this case the properties don't seem to be related in the same way as in the first example. While the first three are physical characteristics, the last property instead indicates to us that Lisa is stuck in a 90's grunge phase. Gina, though she shares several properties with Lisa, might not share the same undying love for Kurt Cobain. Let's try a stronger argument.

(P1) Bob and Dick both wear plaid shirts all the time, wear large plastic-rimmed glasses, and listen to bands you've never heard of.

(P2) Bob drinks PBR.

(C) Dick probably also drinks PBR.

Here we can identify the qualities that Bob and Dick have in common as symptoms of hipsterism. The fact that Bob drinks PBR is another symptom of this affectation. Given that Dick is exhibiting most of the same symptoms, the idea that Dick would also drink PBR is a reasonable assumption to make.

Practical Uses

A procedure very much like Induction by Shared Properties is performed by nurses and doctors when they diagnose a patient's condition. Their thinking goes like this:

(P1) Patients who have elephantitis display an increased heart rate, elevated blood pressure, a rash on their skin, and a strong desire to visit the elephant pen at the zoo.

(P2) The patient here in front of me has an increased heart rate, elevated blood pressure, and a strong desire to visit the elephant pen at the zoo.

(C) It is probable, therefore, that the patient here in front of me has elephantitis.

The more that a patient's symptoms match the 'textbook definition' of a given disease, then the more likely it is that the patient has that disease. Caregivers then treat the patient for the

disease that they think the patient probably has. If the disease doesn't respond to the treatment, or the patient starts to present different symptoms, then they consider other conditions with similar symptoms that the patient is likely to have.

Induction by Shared Relations

Induction by shared relations is much like induction by shared properties, except insofar that what is shared are not properties, but relations. A simple example is the causal relation, from which we might make an inductive argument like this:

(P1) Percocet, Oxycontin and Morphine reduce pain, cause drowsiness, and may be habit forming.

(P2) Heroin also reduces pain and causes drowsiness.

(C) Heroin is probably also habit forming.

In this case the effects of reducing pain, drowsiness, and addiction are all assumed to be caused by the drugs listed. We can use an induction by shared relation to make the probable conclusion that if heroin, like the other drugs, reduces pain and causes drowsiness, it is probably also habit forming.

Another interesting example are the relations we have with other people. For instance, Facebook knows everything about you. But let's focus on the "friends with" relation. They compare who your friends are with the friends of your friends in order to determine who else you might actually know. The induction goes a little like this:

(P1) Donna is friends with Brandon, Kelly, Steve, and Brenda.

(P2) David is friends with Brandon, Kelly, and Steve.

(C) David probably also knows Brenda.

We could strengthen that argument if we knew that Brandon, Kelly, Steve, and Brenda were all friends with each other as well. We could also make an alternate conclusion based on the same argument above:

(C) David probably also knows Donna.

They do, after all, know at least three of the same people. They've probably run into each other at some point.

This page titled [5.2: Cogency and Strong Arguments](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

5.3: Causality and Scientific Reasoning

The main thing to understand here is rather simple:

Always pay close attention to the relationships between correlated events by separating causes from effects and determining which causes produced which effects.

So what do I mean by this? First, remember that correlation simply means that two things happen together. This says nothing about how they relate – I am always around air, but I don't cause the air to exist and air does not cause me to exist. Air is necessary for me to exist, however. Causation is concerned with one event or thing causing another event or thing. Here is an example of these concepts from a few months back when my daughter was 2 years old:

She was coughing a lot and she knows she's sick when she coughs, so she said, "Cough make me sick." Coughing and being sick are correlated, but does coughing make her sick? Probably not.

Perhaps the best way of explaining how these work and their importance is through a contemporary example, that is, unfortunately, controversial. By clarifying the issues, we can carve away the bits that are uncontroversial and figure out what people get so mad about – which is really a quite simple thing, but this is a simple thing that people will disagree a lot about. Here's my example:

Scientists almost universally agree that the following three claims are true: (1) The world is getting warmer at a rate faster than it ever has in the past; (2) The level of carbon dioxide in the atmosphere is increasing at a very fast rate; and (3) The burning of fossil fuels releases a lot of carbon dioxide.

Everyone should be able to accept these as uncontroversial now, but as we know healthy skepticism is a good thing. 10 years ago, the jury was out on these – but now the jury seems to be settled. And honestly, there is no reason for someone to deny these as facts because no one should really care if any of these are true. What people care about are the relationships between these and their effects. If all of these were true and nothing else in the world changed, no one would care. Let's examine these things and see how they might relate: are increasing atmospheric levels of carbon dioxide causing fossil fuels to produce more carbon dioxide? Probably not – it seems like it's the other way, and burning fossil fuels increases the amount of carbon dioxide. So what's the main thing to examine now?

1) Is the burning of fossil fuels causing the carbon dioxide to increase to levels that is causing the world to get warmer? - It seems that the answer is almost definitely yes, but all the impacts and sources of atmospheric carbon dioxide are still being worked out. However, none of this is even if the real issue people care about. In fact, burning fossil fuels might even be completely irrelevant to the real question people care about: 2) If global warming is happening, should people do anything about it? - The effects of global warming should be understood before we can give an answer to this. If the effects are bad, then regardless of the cause, perhaps we should do something to stop or slow global warming. Or perhaps we shouldn't care about it and adapt to a hotter world. Now, if it turns out carbon dioxide emissions by humans are contributing to global warming and it's bad and we think we should do something to stop these bad effects, then perhaps we should cut carbon dioxide emissions. The issue is not one directly about whether global warming is happening, and it never really was: it's about what to do if global warming has detrimental effects and if what we can do is worth doing.

So there you go – the global warming debate simplified by examining causes and effects. So why do people focus so much on the issue of whether or not the earth is getting hotter? Because if it isn't, then maybe there's nothing we need to do. But, even if it is getting hotter, that still doesn't necessarily mean there's something we need to do. Everyone can accept what the scientific community says about these issues because the real point of disagreement is what, if anything, should be done about the problem (if there is one). It is also important to note that in doing analyses like this, you have to appreciate when one thing is sufficient or necessary to produce to another.

Another important thing to remember is the difference between a justification and an explanation. For example, if your car stereo is missing from your car and the window is broken, you would believe your car was burglarized. The *justification* for the belief your car was burglarized is that your radio is missing. The *explanation* for why your radio is missing is that your car was burglarized. Justifications help to support a belief whereas an explanation just gives the information necessary to explain something.

Ockham's (or Occam's) Razor

On Wikipedia at one point, the entry for Occam's razor looked like this:

- Sentence in the introduction: "Other things being equal, a simpler explanation is better than a more complex one." - The first sentence of the overview (which was the next sentence): The principle is often incorrectly summarized as "other things being equal,

a simpler explanation is better than a more complex one.” - Now it says: “It states that among competing hypotheses, the one that makes the fewest assumptions should be selected.” Or, in other words, “don't multiply causes beyond necessity”

Three things about this: Don't trust Wikipedia as much as you might want to, read it carefully, and remember to not make things overly complex.

The last definition is pretty much correct. Here's my example that I always use to illustrate what this means: What happens when I raise my arm? My brain says “move”, tendons do things, muscles do things, bones do things, etc. Now, let's say that all of this is true, BUT at the exact same time, invisible hot pink fairies wearing leather jackets have tied invisible string around my arms and are pulling them. Does this sound plausible to you? It better not – it's ridiculous. Ockham's razor says to forget that extra thing (the fairies) because the first bit of information was enough to explain how my arms move.

This page titled [5.3: Causality and Scientific Reasoning](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#).

5.4: Analogy

27 Analogy⁴⁷

Analogies are comparisons between two things to help in clarification or explanation. They can be used as simple illustrative tools to aid in understanding, like how you might explain to someone that rollerblading is like ice skating on hard, dry surfaces. We use analogies all the time, but for the current lesson, the focus will be on using analogies to make arguments.

An argument from analogy generally has the following form:

- A has properties P,Q,R... - B,C,D... have properties P,Q,R... - B,C,D... also have property Z - Therefore, A probably has property Z

That might make it sound more complicated than it actually is, but that's the technical way in which they work. You observe that something has certain properties, you then observe that something else has many similar properties, AND they have more properties, so that first thing probably has the property as well. For example,

- In-line skating has all the wheels in a line and requires very good balance. - Ice skating has one blade in a straight line on each skate, requires very good balance, and I'm very bad at it. - Therefore, I am probably very bad at in-line skating.

Or,

- Playing Skee-Ball requires you roll a ball at a target and that makes it fun. - Bowling requires that you roll a ball at a target, so that probably makes it fun, too.

When making an argument from analogy, you should always remember to consider important disanalogies, because one important disanalogy can make the argument fall apart. For an analogy to work, all of the aspects that are being compared need to be true, relevant, important, and absent any important disanalogies! So, is the following a good analogy?

- Cars pollute a lot, so Tesla Roadsters pollute a lot.

Generally, arguments from analogy are stronger when there are more and closer analogies used in the argument (and Tesla Roadsters have a lot of similarities with regular cars), but a single important disanalogy (Tesla Roadsters are electric cars) can destroy the argument.

What makes arguments from analogy better?

1) The argument cites more and closer analogies that are more important 2) There are fewer or less important disanalogies between the object in the conclusion and the other objects 3) The objects cited only in the premises are more diverse. 4) The conclusion is weaker

As an exercise, make an argument by analogy and then go about modifying it. How can it be made stronger? Why will that make it stronger?

This page titled [5.4: Analogy](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#)

5.5: Statistical Reasoning- Bayes' Theorem

Frequency diagrams: A first look at Bayes

Bayesian reasoning is about how to revise our beliefs in the light of evidence. We'll start by considering one scenario in which the strength of the evidence has clear numbers attached. (Don't worry if you don't know how to solve the following problem. We'll see shortly how to solve it.)

Suppose you are a nurse screening a set of students for a sickness called Diseasitis.¹

- You know, from past population studies, that around 20% of the students will have Diseasitis at this time of year.

You are testing for Diseasitis using a color-changing tongue depressor, which usually turns black if the student has Diseasitis.

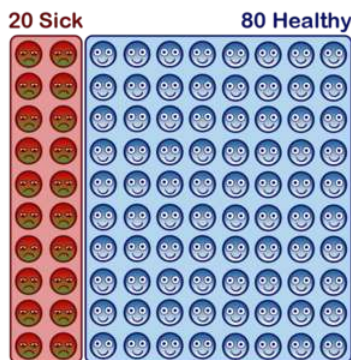
- Among patients with Diseasitis, 90% turn the tongue depressor black.
- However, the tongue depressor is not perfect, and also turns black 30% of the time for healthy students.

One of your students comes into the office, takes the test, and turns the tongue depressor black. What is the probability that they have Diseasitis?

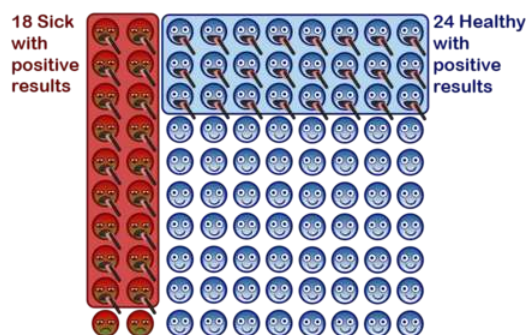
(If you think you see how to do it, you can try to solve this problem before continuing. To quickly see if you got your answer right, you can expand the "Answer" button below; the derivation will be given shortly.)

The probability a student with a blackened tongue depressor has Diseasitis is $\frac{3}{7}$, roughly 43%. This problem can be solved a hard way or a clever easy way. We'll walk through the hard way first.

First, we imagine a population of 100 students, of whom 20 have Diseasitis and 80 do not.²



90% of sick students turn their tongue depressor black, and 30% of healthy students turn the tongue depressor black. So we see black tongue depressors on $90\% \times 20 = 18$ sick students, and $30\% \times 80 = 24$ healthy students.



What's the probability that a student with a black tongue depressor has Diseasitis? From the diagram, there are 18 sick students with black tongue depressors. $18 + 24 = 42$ students in total turned their tongue depressors black. Imagine reaching into a bag of all the students with black tongue depressors, and pulling out one of those students at random; what's the chance a student like that is sick?



The final answer is that a patient with a black tongue depressor has an $18/42 = 3/7 = 43\%$ probability of being sick.

Many medical students have at first found this answer counter-intuitive: The test correctly detects Diseasitis 90% of the time! If the test comes back positive, why is it still less than 50% likely that the patient has Diseasitis? Well, the test also incorrectly "detects" Diseasitis 30% of the time in a healthy patient, and we start out with lots more healthy patients than sick patients.

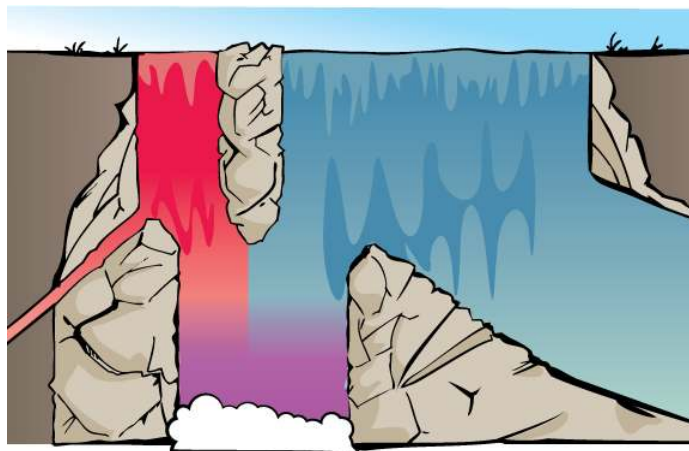
The test does provide *some* evidence in favor of the patient being sick. The probability of a patient being sick goes from 20% before the test, to 43% after we see the tongue depressor turn black. But this isn't conclusive, and we need to perform further tests, maybe more expensive ones.

If you feel like you understand this problem setup, consider trying to answer the following question before proceeding: What's the probability that a student who does *not* turn the tongue depressor black - a student with a negative test result - has Diseasitis? Again, we start out with 20% sick and 80% healthy students, 70% of healthy students will get a negative test result, and only 10% of sick students will get a negative test result.

Imagine 20 sick students and 80 healthy students. $10\% * 20 = 2$ sick students have negative test results. $70\% * 80 = 56$ healthy students have negative test results. Among the $2+56=58$ total students with negative test results, 2 students are sick students with negative test results. So $2/58 = 1/29 = 3.4\%$ of students with negative test results have Diseasitis.

Now let's turn to a faster, easier way to solve the same problem.

Imagine a waterfall with two streams of water at the top, a red stream and a blue stream. These streams separately approach the top of the waterfall, with some of the water from both streams being diverted along the way, and the remaining water falling into a shared pool below.



Suppose that:

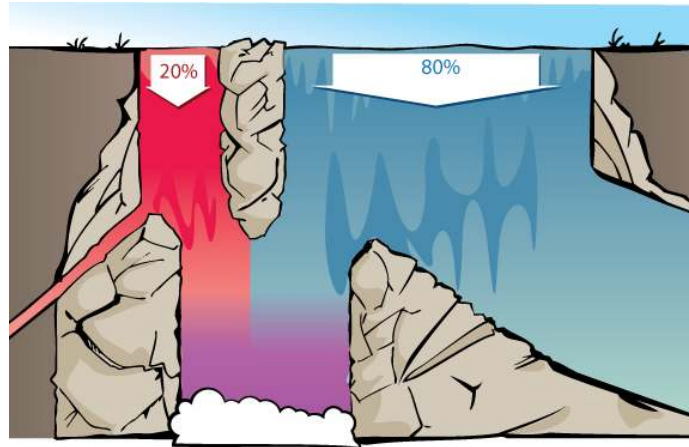
- At the top of the waterfall, 20 gallons/second of red water are flowing down, and 80 gallons/second of blue water are coming down.
- 90% of the red water makes it to the bottom.
- 30% of the blue water makes it to the bottom.

Of the purplish water that makes it to the bottom of the pool, how much was originally from the red stream and how much was originally from the blue stream?

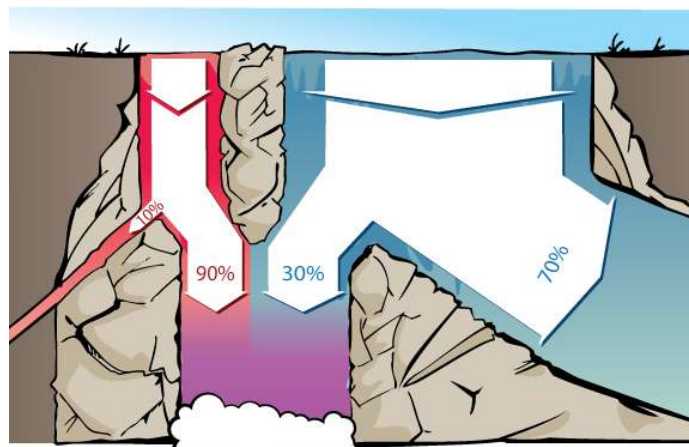
This is structurally identical to the Diseasitis problem from before:

- 20% of the patients in the screening population start out with Diseasitis.
- Among patients with Diseasitis, 90% turn the tongue depressor black.
- 30% of the patients without Diseasitis will also turn the tongue depressor black.

The 20% of sick patients are analogous to the 20 gallons/second of red water; the 80% of healthy patients are analogous to the 80 gallons/second of blue water:



The 90% of the sick patients turning the tongue depressor black is analogous to 90% of the red water making it to the bottom of the waterfall. 30% of the healthy patients turning the tongue depressor black is analogous to 30% of the blue water making it to the bottom pool.



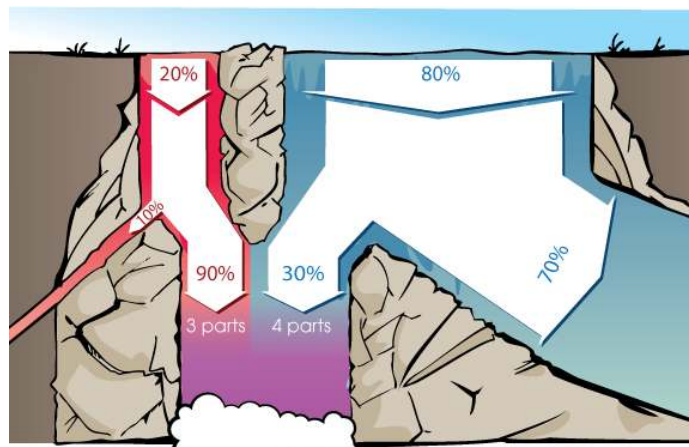
Therefore, the question "what portion of water in the final pool came from the red stream?" has the same answer as the question "what portion of patients that turn the tongue depressor black are sick with Diseasitis?"

Now for the faster way of answering that question.

We start with *4 times as much blue water as red water* at the top of the waterfall.

Then each molecule of red water is 90% likely to make it to the shared pool, and each molecule of blue water is 30% likely to make it to the pool. (90% of red water and 30% of blue water make it to the bottom.) So each molecule of red water is *3 times as likely* ($0.90 / 0.30 = 3$) as a molecule of blue water to make it to the bottom.

So we multiply prior proportions for red vs. blue by relative likelihoods of and end up with final proportions that mean that the bottom pool has 3 parts of red water to 4 parts of blue water.



To convert these *relative* proportions into an *absolute* probability that a random water molecule at the bottom is red, we calculate $3 / (3 + 4)$ to see that 3/7ths (roughly 43%) of the water in the shared pool came from the red stream.

This proportion is the same as the 18 : 24 sick patients with positive results, versus healthy patients with positive test results, that we would get by thinking about 100 patients.

That is, to solve the Diseasitis problem in your head, you could convert this word problem:

20% of the patients in a screening population have Diseasitis. 90% of the patients with Diseasitis turn the tongue depressor black, and 30% of the patients without Diseasitis turn the tongue depressor black. Given that a patient turned their tongue depressor black, what is the probability that they have Diseasitis?

Okay, so the initial odds are $(20\% : 80\%) = (1 : 4)$, and the likelihoods are $(90\% : 30\%) = (3 : 1)$. Multiplying those ratios gives final odds of $(3 : 4)$, which converts to a probability of 3/7ths.

(You might not be able to convert 3/7 to 43% in your head, but you might be able to eyeball that it was a chunk less than 50%.)

You can try doing a similar calculation for this problem:

- 90% of widgets are good and 10% are bad.
- 12% of bad widgets emit sparks.
- Only 4% of good widgets emit sparks.

What percentage of sparking widgets are bad? If you are sufficiently comfortable with the setup, try doing this problem entirely in your head.

(You might try visualizing a waterfall with good and bad widgets at the top, and only sparking widgets making it to the bottom pool.)

- There's $(1 : 9)$ bad vs. good widgets.
- Bad vs. good widgets have a $(12 : 4)$ relative likelihood to spark.
- This simplifies to $(1 : 9) \times (3 : 1) = (3 : 9) = (1 : 3)$, 1 bad sparking widget for every 3 good sparking widgets.
- Which converts to a probability of $1/(1+3) = 1/4 = 25\%$; that is, 25% of sparking widgets are bad.

Seeing sparks didn't make us "believe the widget is bad"; the probability only went to 25%, which is less than 50/50. But this doesn't mean we say, "I still believe this widget is good!" and toss out the evidence and ignore it. A bad widget is *relatively more likely* to emit sparks, and therefore seeing this evidence should cause us to think it *relatively more likely* that the widget is a bad one, even if the probability hasn't yet gone over 50%. We increase our probability from 10% to 25%.

Waterfalls are one way of visualizing the "odds form" of "Bayes' rule", which states that the prior odds times the likelihood ratio equals the posterior odds. In turn, this rule can be seen as formalizing the notion of "the strength of evidence" or "how much a piece of evidence should make us update our beliefs".

This page titled [5.5: Statistical Reasoning- Bayes' Theorem](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

5.6: Legal Reasoning and Moral Reasoning

By employing a healthy skepticism and dosage of reasonable doubt, we can be sure that what we believe has been hard-earned through careful and cautious analysis. In this discussion of moral reasoning, we will learn how to decide what to do. In this sense, moral reasoning is the most practical part of the process. When we reason about morality we build arguments, just like when we reason about anything else. But arguments involving moral propositions have to be constructed in a special way. This is partly to help us avoid the Naturalistic Fallacy. But it is also to help ensure that our arguments about morality are consistent.

Features of Moral Arguments

The main thing that makes an argument about morality distinct from other kinds of arguments is that moral arguments are made of moral statements, at least in part. A moral statement, as you might guess, is a statement about morality: it is a statement that says something about what's right or wrong, good or evil, just or unjust, virtuous and wicked. Moral statements are not like other propositions: they do not talk about what is the case or not the case. Rather, moral statements talk about what should be the case, or what should not be the case. Look for moral indicator words like 'should', 'ought', 'must', 'is right', 'is wrong', and the like. And look for the language of character-qualities, like 'temperance', 'prudence', 'friendship', 'coldness', 'generosity', 'miserliness', and so on. Sometimes, sentences written in the imperative voice (i.e. sentences which are commands) are moral statements in which some of the moral indicator words have been left out.

Thus, a sentence like "Share your toys!" could mean, "You should share your toys!" But to be fully logical, it's necessary to phrase imperative sentences that way in order to fit them into moral arguments, and find out whether they are sound. It's also easy to fall into the fallacy of equivocation. Words like 'good' can have a moral and a non-moral meaning: we don't use the word 'goodness' the same way when we speak of good snow boots, and good people. With that in mind, which of the following are moral statements, and which are not?

- Peter should keep his promise to you.
- Peter did keep his promise to you.
- Human stem cell research is wrong.
- Some people think that human stem cell research is wrong.
- My mother is a good person.
- My mother tries to be a good person.
- This pasta dinner is really good.
- Finish your dinner!
- It's wrong to cheat on tests.
- Information gathered from terror suspects via torture can't be trusted.
- Torturing people suspected of terrorism is barbaric and criminal.
- You've always been a good friend to me.
- Proper etiquette demands that we treat guests with respect.

As mentioned, moral arguments are made of moral statements. This means that the conclusion is a moral statement, and at least one of the premises is also a moral statement. As we saw in the discussion of deductions, nothing can appear in the conclusion that was not present somehow in at least one of the premises. So, if you have a moral statement for a conclusion, you need a moral statement somewhere in the argument as well. Without one, the argument is an instance of the Naturalistic Fallacy, and it's unsound. Consider these examples:

(P1) It's wrong to steal candy from babies.

(P2) Little Sonny-Poo-Poo is a baby.

(C) Therefore, it's wrong to steal candy from Little Sonny-Poo-Poo.

In this example, P1 is a general claim about moral principles, and P2 is a factual statement. Together, they lead us to the conclusion, which passes a moral judgment about the particular case described in P2. So while it ultimately can be seen as valid, the truth of (P1) requires much further defense.

(P1) Jolts of electricity are very painful.

(P2) Some of the prisoners have been interrogated using electric jolts.

(C) It is wrong to torture people using electric jolts.

In this example, both P1 and P2 are both factual claims. But the conclusion is a moral statement. Since there's no moral statement among the premises, this argument is unsound. Now there might be an implied, unstated general moral principle which says that it's wrong to inflict pain on people. And some readers might unconsciously fill in that premise, and declare the argument sound that way. But remember, when examining an argument, the only things you can examine are what's actually in front of you.

Legal Reasoning⁵⁰

Legal reasoning, for our purposes, is actually quite simple. To employ legal reasoning means that within the confines of the legal system, you use the logical methods we have employed to arrive at a conclusion of how to apply the law. So, if you want to figure out whether or not something is legal, you look to the relevant laws, combine them using logic, and you have answer.

However, nothing is always this simple. There are fallacies often committed with legal reasoning of two kinds:

1. Whatever is right is legal, and whatever is wrong is illegal.
2. Whatever is legal is right, and whatever is illegal is wrong.

You'll notice that these are all moral claims, and we are not entitled to make these claims. Indeed, we can find examples that disprove each of these (it's right to steal medicine to save a life but it's not legal, it's wrong to cheat on your spouse but it's not illegal). However, in general, we do like the laws to match up with our moral reasonings. Whenever making any arguments, it's always important to understand the relevant laws and how they impact (for better or worse) the claims and conclusions you are making.

This page titled [5.6: Legal Reasoning and Moral Reasoning](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin](#) (NGE Far Press) .

5.7: Editing Your Final Essay

You've made it to the end of this course on learning how to read and write critically! Now you have to implement and combine everything you've learned. In short, you need to:

1) Be sure each and every sentence and word are properly chosen to accurately represent what you want to say 2) Clearly state your conclusion and your premises and

1. Ensure your argument is valid
2. All of your premises are supported by cogent inductive arguments

3) Avoid all fallacies 4) Be aware of counterarguments that people might make and account for them in your essay 5) Make sure that each sentence connects to the next and each paragraph connects to the next 6) You don't say anything that isn't helping to directly support your conclusion 7) Liven up your essay by using fun examples

Spell-check and grammar-check in a word processor are not enough. Read and re-read and edit and re-edit and ask anyone else to proofread your paper for you. Good luck.

This page titled [5.7: Editing Your Final Essay](#) is shared under a [CC BY-NC-SA](#) license and was authored, remixed, and/or curated by [Noah Levin \(NGE Far Press\)](#) .

Index

A

Abusing The Man Fallacy

3.2: Fallacies of Evidence

Amphiboly

3.4: Fallacies of Ambiguity and Grammatical Analogy

Analogy

5.4: Analogy

Appeal to Authority

3.2: Fallacies of Evidence

Appeal to Force

3.2: Fallacies of Evidence

Appeal to Popularity

3.2: Fallacies of Evidence

B

Barnum effect

1.4: Distinction of Proof from Verification; Our Biases and the Forer Effect

Bayes' Theorem

5.5: Statistical Reasoning- Bayes' Theorem

biconditionals

2.1: Techniques of Defining- "Semantics" vs "Syntax" and Avoiding more Ambiguity

C

claims

1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall

Cogency

5.2: Cogency and Strong Arguments

Cognitive meaning

2.4: Cognitive and Emotive Meaning - Abortion and Capital Punishment

composition fallacy

3.3: Fallacies of Weak Induction

conjunction

4.2: Statements and Symbolizing

Connectives

4.2: Statements and Symbolizing

D

Disjunction

4.2: Statements and Symbolizing

E

Emotive Meaning

2.4: Cognitive and Emotive Meaning - Abortion and Capital Punishment

equivocation

3.4: Fallacies of Ambiguity and Grammatical Analogy

F

Fallacy of Division

3.3: Fallacies of Weak Induction

Fallacy of the Undistributed Middle

3.4: Fallacies of Ambiguity and Grammatical Analogy

False Dilemma

3.4: Fallacies of Ambiguity and Grammatical Analogy

Forer effect

1.4: Distinction of Proof from Verification; Our Biases and the Forer Effect

Formal Fallacies

4.6: Formal Fallacies

Framing Language

2.4: Cognitive and Emotive Meaning - Abortion and Capital Punishment

G

Grenzsituationen

2.4: Cognitive and Emotive Meaning - Abortion and Capital Punishment

I

Induction

5.2: Cogency and Strong Arguments

informal fallacies

3: Informal Fallacies - Mistakes in Reasoning

L

Legal Reasoning

5.6: Legal Reasoning and Moral Reasoning

Loaded Question Fallacy

3.4: Fallacies of Ambiguity and Grammatical Analogy

Ludwig Wittgenstein

2: Language - Meaning and Definition

M

Monty Hall

1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall

Moral Arguments

5.6: Legal Reasoning and Moral Reasoning

N

Naturalistic Fallacy

3.2: Fallacies of Evidence

Non sequitur

3.2: Fallacies of Evidence

O

Objective claims

1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall

Occam's Razor

5.3: Causality and Scientific Reasoning

Ockham's Razor

5.3: Causality and Scientific Reasoning

P

parentheses

4.2: Statements and Symbolizing

post hoc ergo propter hoc

3.3: Fallacies of Weak Induction

propositions

1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall

R

Red herring

3.2: Fallacies of Evidence

S

scientific method

1.5: The Scientific Method

semantics

2.1: Techniques of Defining- "Semantics" vs "Syntax" and Avoiding more Ambiguity

Sentence letters

4.2: Statements and Symbolizing

Sentential logic

4.2: Statements and Symbolizing

skepticism

1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall

statements

1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall

straw man

3.2: Fallacies of Evidence

strong inductive arguments

5.2: Cogency and Strong Arguments

Subjective claims

1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall

syntax

2.1: Techniques of Defining- "Semantics" vs "Syntax" and Avoiding more Ambiguity

V

Vacuity Fallacy

3.4: Fallacies of Ambiguity and Grammatical Analogy

W

Weak Analogy

3.4: Fallacies of Ambiguity and Grammatical Analogy

weak inductive arguments

5.2: Cogency and Strong Arguments

Glossary

Sample Word 1 | Sample Definition 1

Detailed Licensing

Overview

Title: [Critical Reasoning and Writing \(Levin et al.\)](#)

Webpages: 49

Applicable Restrictions: Noncommercial

All licenses found:

- [CC BY-NC-SA 4.0](#): 87.8% (43 pages)
- [Undeclared](#): 12.2% (6 pages)

By Page

- [Critical Reasoning and Writing \(Levin et al.\) - CC BY-NC-SA 4.0](#)
 - [Front Matter - CC BY-NC-SA 4.0](#)
 - [TitlePage - CC BY-NC-SA 4.0](#)
 - [InfoPage - CC BY-NC-SA 4.0](#)
 - [Table of Contents - Undeclared](#)
 - [Licensing - Undeclared](#)
 - [Preface - Undeclared](#)
 - [1: Introduction to Critical Thinking, Reasoning, and Logic - CC BY-NC-SA 4.0](#)
 - [1.1: Prelude to Chapter - CC BY-NC-SA 4.0](#)
 - [1.2: Introduction and Thought Experiments- The Trolley Problem - CC BY-NC-SA 4.0](#)
 - [1.3: Truth and Its Role in Argumentation - Certainty, Probability, and Monty Hall - CC BY-NC-SA 4.0](#)
 - [1.4: Distinction of Proof from Verification; Our Biases and the Forer Effect - CC BY-NC-SA 4.0](#)
 - [1.5: The Scientific Method - CC BY-NC-SA 4.0](#)
 - [1.6: Diagramming Thoughts and Arguments - Analyzing News Media - CC BY-NC-SA 4.0](#)
 - [1.7: Creating a Philosophical Outline - CC BY-NC-SA 4.0](#)
 - [2: Language - Meaning and Definition - CC BY-NC-SA 4.0](#)
 - [2.1: Techniques of Defining- “Semantics” vs “Syntax” and Avoiding more Ambiguity - CC BY-NC-SA 4.0](#)
 - [2.2: Criteria for Framing Definitions- It’s all about Context and Audience - CC BY-NC-SA 4.0](#)
 - [2.3: Defining Terms Appropriately - CC BY-NC-SA 4.0](#)
 - [2.4: Cognitive and Emotive Meaning - Abortion and Capital Punishment - CC BY-NC-SA 4.0](#)
 - [2.5: Functions of Language and Precision in Speech - CC BY-NC-SA 4.0](#)
 - [2.6: Defining Terms- Types and Purposes of Definitions - CC BY-NC-SA 4.0](#)
 - [3: Informal Fallacies - Mistakes in Reasoning - CC BY-NC-SA 4.0](#)
 - [3.1: Classification of Fallacies - All the Ways we Say Things Wrong - CC BY-NC-SA 4.0](#)
 - [3.2: Fallacies of Evidence - CC BY-NC-SA 4.0](#)
 - [3.3: Fallacies of Weak Induction - CC BY-NC-SA 4.0](#)
 - [3.4: Fallacies of Ambiguity and Grammatical Analogy - CC BY-NC-SA 4.0](#)
 - [3.5: The Detection of Fallacies in Ordinary Language - CC BY-NC-SA 4.0](#)
 - [3.6: Searching Your Essays for Fallacies - CC BY-NC-SA 4.0](#)
 - [4: Deductive Arguments - CC BY-NC-SA 4.0](#)
 - [4.1: Prelude to Deductive Arguments - CC BY-NC-SA 4.0](#)
 - [4.2: Statements and Symbolizing - CC BY-NC-SA 4.0](#)
 - [4.3: Propositions, Inferences, and Judgments - CC BY-NC-SA 4.0](#)
 - [4.4: Validity and Soundness - CC BY-NC-SA 4.0](#)
 - [4.5: Commons Forms of Arguments - CC BY-NC-SA 4.0](#)
 - [4.6: Formal Fallacies - CC BY-NC-SA 4.0](#)
 - [4.7: Formalizing your Arguments - CC BY-NC-SA 4.0](#)
 - [5: Inductive Arguments - CC BY-NC-SA 4.0](#)
 - [5.1: Prelude to Inductive Arguments - CC BY-NC-SA 4.0](#)
 - [5.2: Cogency and Strong Arguments - CC BY-NC-SA 4.0](#)
 - [5.3: Causality and Scientific Reasoning - CC BY-NC-SA 4.0](#)
 - [5.4: Analogy - CC BY-NC-SA 4.0](#)
 - [5.5: Statistical Reasoning- Bayes’ Theorem - CC BY-NC-SA 4.0](#)
 - [5.6: Legal Reasoning and Moral Reasoning - CC BY-NC-SA 4.0](#)
 - [5.7: Editing Your Final Essay - CC BY-NC-SA 4.0](#)
 - [Back Matter - CC BY-NC-SA 4.0](#)

- [Index](#) - *Undeclared*
- [Glossary](#) - *Undeclared*
- [Detailed Licensing](#) - *Undeclared*