

Logical reasoning application: constructing an argument¹

Introduction

This article builds on *The Elements of Logical Reasoning*² as we resume our discussion on critical thinking and logical reasoning. The two fundamental principles that constitute the construction of a good argument are the main objective of this paper. These two principles comprise valuable tools to enable true mastery in the art of argumentation.

Imagine stepping into a fantastical and alternative universe of strange happenings and *unpredictability*. Join Alice as she bumps into a pair of rotund identical twins, Tweedledum and Tweedledee:³

'Contrariwise, continued Tweedledee, if it was so, it might be; and if it were so, it would be; but as it isn't, it ain't. That's logic.'

Now, consider stepping into another fantastical and alternative universe, based on *first principles*. Join Elon Musk who, in partnership with NASA, launched SpaceX's Crew Dragon capsule into outer space on 30 May 2020.⁴

The path to success and greatness is about continually mastering and perfecting the basics. It provides the foundation on which we build and improve, and it is the combination of these constituent elements that upholds a complex whole. Musk defines this as '*boiling things down to fundamental truths and going from there*'. In the field of critical thinking, this is called *arguing from first principles*. This approach is defined by a starting point of claims and statements that are certain, and reasoning from the bottom up in a logical and acceptable manner. More eloquently put by Charlie Munger:⁵ '*If the facts don't hang together on a latticework of theory, you don't have them in useable form.*'

An *argument*, we said, is the combination of statements (i.e. claims and beliefs) with a recognisable form – that is, where a statement or a group of statements, called the *premises*, are intended to prove, substantiate and support another statement, the *conclusion*.

Arguments

Arguments are the main focus of critical thinking. An understanding of the underlying dynamics and structure of different argument types is the most important first principle in logical reasoning. This level of command, albeit somewhat technical, enables us to evaluate and formulate arguments that are worthy of acceptance.

Arguments come in two forms – *deductive* and *inductive*. A *deductive argument* is intended to provide logically *conclusive* support for its conclusion while an *inductive argument* is intended to provide *probable* support for its conclusion.

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² Breitenbach (2020). *Arbitrarily Speaking*. E-periodical, 3rd edition.

³ *Through the Looking-Glass and What Alice Found There* (1871) is a sequel to *Alice's Adventures in Wonderland*. Lewis Carroll was an accomplished mathematician, poet, satirist, philosopher, photographer and inventor. His children books are celebrated for their blend of playful (though sophisticated) logic, social satire, and exuberant fantasy.

⁴ Elon Musk is the CEO of SpaceX and Tesla Motors and chairman of SolarCity.

⁵ Munger is an investor, businessman and philanthropist and is better known as the right-hand man of Warren Buffet (Griffin, 2015).

Examples of these argument types, with common indicator words, are outlined in the table below:

	Deductive argument	Inductive argument
Premise	All dogs have fleas.	Most dogs have fleas.
Premise	Milo is a dog.	Milo is a dog.
Conclusion	Milo <i>has</i> fleas.	Milo <i>probably</i> has fleas.
Indicator words and phrases	<i>Absolutely</i>	<i>Likely</i>
	<i>Certainly</i>	<i>Probably</i>
	It <i>necessarily</i> follows ...	It is <i>plausible</i> that ...
	It <i>logically</i> follows ...	The <i>chances</i> or <i>odds</i> are ...

Deductive and inductive arguments are often used together, as both these types may be interwoven into one supporting argument for a single case – presented as such to support the granting of a final judgement or making of an award in that case.

Both deductive and inductive arguments rest on two fundamental principles – (a) the logical structure and (b) the truth of the supporting premises. The *logical structure* refers to the way that the premises and the conclusion fit together to make sense. The *truth* of the premises refers to the content of each of the supporting claims, i.e. whether each of them is true or false.

For example:

Logical structure		
	Correct pattern	Incorrect pattern
Premise	All dogs are mammals.	All dogs are mammals.
Premise	Milo is a dog.	All cows are mammals.
Conclusion	Therefore, Milo is a mammal.	Therefore, all dogs are cows.

Premise truth		
	Correct pattern with <i>true</i> premises	Correct pattern with <i>untrue</i> premises
Premise	All dogs are mammals.	All dogs are marsupials.
Premise	Milo is a dog.	Milo is a dog.
Conclusion	Therefore, Milo is a mammal.	Therefore, Milo is a marsupial.

To clarify and simplify we shall address *logical structure* and *premise truth* separately.

(a) **Logical structure**

Although full cognition of logical structures appears to be quite technical, we are now in the heart of arguing from *first principle* and *boiling things down to elemental truths*.

Mastering the skill to recognise and apply argument forms that makes logical sense results in the ability to deliver valid, strong and sophisticated arguments. Consider this argument from Ambrose Bierce:⁶

*'Sixty men can do a piece of work sixty times as quickly as one man.
One man can dig a posthole in sixty seconds.
Therefore, sixty men can dig a posthole in one second.'*
(Own emphasis)

It is clear that this argument does not make logical sense: The expression *sixty times* in the first line of Bierce's argument, was taken out of context and literally translated into the concept of *time*, i.e. minutes and seconds, while the conceptual emphasis should be on the phrase '*a piece of work sixty times*', simultaneously understanding it as a whole concept. It therefore should read like this:

*'Sixty men can do a piece of work sixty times as quickly as one man.
One man can dig a posthole in sixty seconds.
Therefore, sixty men can dig 60 postholes in sixty seconds.'*
(Own emphasis)

Although the absurdity of this example is quite evident, most illogical arguments are a little harder to recognise.

Affirming the Antecedent

Fortunately, since *argument forms* are distinct from *argument content* (i.e. premise truth), we can use letters to represent statements to signify different patterns. Each letter represents a different statement in much the same way that letters are used to represent values in a mathematical equation.

For instance,

*If it rains outside, then I will not go to the park.
It rains outside.
Therefore, I will not go to the park,*

translates into:

If *a*, then *b*.
a (affirmed to be true)
Therefore, *b*.

This argument pattern is called *Affirming the Antecedent*, and it is *always* valid. An *antecedent* is the *if*-part of the statement (symbolised as an '*a*') that precedes the consequent, the *then*-part of the statement (symbolised as a '*b*').

⁶ Bierce (1842 - 1914) was a short story writer, journalist, poet and Civil War veteran. His book, *The Devil's Dictionary*, is named as one of the 100 greatest's masterpieces of American literature.

Denying the Consequent

Another valid and commonly used argument type is *Denying the Consequent*. The *consequent* is the *then*-part, symbolised as *b*, that follows after the *if*-part of a statement. Here an example to illustrate:

For instance,

If the schools are closed, then it is a public holiday.

It is not a public holiday.

Therefore, the schools are not closed,

translates into:

If a, then b.

Not b.

Therefore, not a.

Hypothetical Syllogisms

Let us examine the formula for a *Hypothetical Syllogism* – an argument pattern that is often used in court procedures where a number of scenarios are created to test probability.

For instance,

If the ball drops, the lever turns to the right.

If the lever turns to the right, the engine will stop.

Therefore, if the ball drops, the engine will stop,

translates into:

If a, then b.

If b, then c.

Therefore, if a, then c.

These three argument patterns, that is, *Affirming the Antecedent (AA)*, *Denying the Consequent (DC)* and *Hypothetical Syllogisms (HS)* are *always* valid.

When we get the argument patterns wrong, we are constructing *invalid* and *weak* arguments. Examples of illogical and invalid arguments are *Affirming the Consequent (AC)* and *Denying the Antecedent (DA)*.

Consider this example of *Affirming the Consequent*:

If Claire has caffeine at night, she is unable to sleep.

Claire is unable to sleep.

Therefore, Claire had caffeine at night,

translates into this incorrect formula:

If a, then b.

b (affirmed to be true)

Therefore, a.

The problem with this argument pattern is that although it is indeed possible that caffeine was the reason for Claire's sleeplessness, it is also possible that Claire was unable to sleep

because she was in love, or that the neighbours had a noisy party, or that she felt guilty about something. When we construct an invalid argument, by either *Affirming the Consequent* or

Denying the Antecedent, we leave ourselves wide open to many alternative options and interpretations that inevitably will render our arguments vague, unsubstantiated, invalid and weak.

Applying the correct argument patterns, i.e. *logical form*, ensures that arguments are *valid* and *strong*. But, having said that, we also need to be certain that the supporting premises are true and acceptable. This *second fundamental principle* of a good argument guarantees that our arguments are also *sound* and *cogent*.

(b) The Truth of Supporting Premises

What we believe is the invisible force behind our behaviour. It informs and guide our choices and decisions. Therefore, it is imperative that we have good reasons for accepting those beliefs. It is, of course, easier to make decisions when we are familiar with and knowledgeable about a specific subject,⁷ but as an arbiter one may encounter any number of cases covering a broad spectrum of issues and topics in an array of different fields, covering anything from environmental to economic issues, electronic commerce to entertainment, immigration to intellectual property, dying cats to burning bridges.

Below are some guidelines to avoid pitfalls when confronted with supporting premises.

- *Weasel words*⁸ is the informal term for words and vague phrases designed to sound authoritative or meaningful, but generally actually lacking in real content and true meaning. They are typically used to persuade without evidence, inform without information or to promise without commitment. Some of these words can be crafted into an infinite number of technically true, but misleading claims. These words, of course, can have perfectly respectable uses as necessary qualifiers in many contexts, but be vigilant when you encounter words and phrases such as these:

Weasel words	Weasel phrases
Reportedly	Critics point out ...
Virtually	There is evidence that ...
Many	A growing body of evidence indicates ...
Seems	Many South Africans feel ...

- *Sweeping statements* also require reasonable scepticism and a critical approach. A *sweeping statement* is a broad generalisation without considering all the relevant facts carefully. Donald Trump, for instance, while speaking at a rally in Alabama in 2015, claimed that he had seen ‘*thousands and thousands*’ of Muslims on TV cheering the collapse of the World Trade Centre.⁹ This was a lie. When we encounter *sweeping*

⁷ Having said that, being exposed to a number of different fields enhances cognitive diversity. Being an outsider, for instance, primes the human brain for innovative thinking, and steers one away from what is referred to as the *echo chamber* of the mind. Moving between different fields of enquiry was a practice adopted by Charles Darwin; he alternated his research between botany, zoology, geology and psychology to give him a fresh perspective and allowed him to draw ideas together across fields (Syed, 2020).

⁸ During a speech in St. Louis, on 31 May 1916, Theodore Roosevelt argued that ‘*one of our defects as a nation is a tendency to use what have been called weasel words. When a weasel sucks eggs it sucks the meat out of the egg and leaves it an empty shell. If you use a weasel word after another there is nothing left of the other*’ (Crystal, 2000).

⁹ PolitiFact and the *Washington Post* checked all the news reports and TV broadcasts of 9/11 and also checked all news platforms the three months afterward. Nothing was found to corroborate Trump’s statement (Levitan, 2017).

statements, we need to examine the root intention of such claims (such as slanting), the sources, and the context (finding missing facts or identifying false emphasis, for instance).

The truth of so-called '*generally accepted*' information, i.e. counter knowledge, should also be examined. *Counter-knowledge* is false information, usually based on a misconception that many people perceive as, or unthinkingly assume to be, true. Take for instance the notion that '*the flu vaccination causes flu*'. Just because two events occur consecutively does not imply that the one has caused the other. This example also illustrates the presence of confounding factors.

- *Confounding factors* are those facts that are often missing or much less obvious, but correct. An interesting example is the significant drop in crime in the USA during the 1990s. It was presumed that it was primarily because of better policing, but after thorough research it was determined that the drop resulted from the widespread legalisation of abortion in the 1970s.¹⁰
- *Statistics are persuasive. So much so that individuals, organisations and even whole countries* base some of their most important decisions on organised data. Numbers inform but can be equally misleading. In this regard, Mark Twain popularised the saying that: '*there are lies, damned lies and statistics.*'

Average, for instance is a commonly used term, but there is an important distinction between *mean average*, *mode average* and *median average*.¹¹ *Graphs* can be equally misleading as values on *axes* can be changed to produce steeper or smoother curves. Even visually simple graphics like pie charts can be manipulated. We need to be vigilant when presented with facts and figures and keep in mind that it gets considerably more complex when we are presented with graphs that emphasise only *certain* aspects – we need to consider and understand the full context of the presented data.

Needless to say, data obtained from *surveys* can also easily be skewed. A *stratified sample*, for instance, is critical for conducting a representative survey. To enable us to fully understand the conclusion or outcome of a survey, it is important to always interpret the details *and* the context of the study.

Apart from testing the truth of supporting premises, we are also often confronted with *equally compelling*, or *conflicting*, *claims*. Some helpful suggestions on how to evaluate such statements and to decide which claim is worthy of acceptance, are set out below.

In 1983, the psychologists Amos Tversky and Daniel Kahneman presented a now-famous thought experiment that considered the following:¹²

Linda is 31, single, outspoken and clever. She studied philosophy and attended demonstrations at university. Which is more likely: that Linda is a bank teller or that Linda is a bank teller who is active in the feminist movement?

Most people opted for the second option. This brings us to Ockham's razor:¹³

Ockham's razor states that when we are confronted with *equally plausible* and *competing assumptions*, the simple claim is more likely to be true. This ties in with the conjunction fallacy. The *conjunction fallacy* states that the probability of two events occurring in '*conjunction*' is always less than or equal to the probability of one event occurring alone.

¹⁰ Fewer births of unwanted children meant that fewer children were growing up in the kinds of difficult circumstances that often lead to criminality (Dubner & Levitt, 2015).

¹¹ The *mean average* is the number that is yielded if all values are added together and divided by the number of values. The *mode average* is the value that occurs most frequently. The *median average* is the '*middle*' value when all values are listed from small to large.

¹² Weinberg & McCann, L 2019.

¹³ The second-century Roman astronomer Ptolemy, argued that it was a '*good principle to explain phenomena by the simplest hypothesis possible.*' Twelve hundred years later, the English philosopher William of Ockham reached the same conclusion.

Furthermore, when we are confronted with conflicting claims we are entitled to rely on our *own personal experience* or on the opinion of an *expert*.

- If we do not have a good reason to doubt our own knowledge and personal experience, then we do not need much additional evidence and are justified in then also believing that – what we think is true – to be true. That is, *if* we trust that our beliefs are unimpeded by cognitive bias. *Cognitive bias* is the subconscious programming that causes us to favour simple intuition at the expense of objective analysis, resulting in logical errors and miscalculated probability, value or risk.¹⁴

If we, on the other hand, have strong doubts about a claim, we are entitled to assign low credibility to it. This process, of weighing and testing the probability of the truth of a claim based on its relationship to prior knowledge, is known as the *Bayesian method*.¹⁵

- When we are unsure and an unsupported claim conflicts with our prior knowledge it is advisable to consult an *expert*. Since experts are familiar with the established facts and existing data in their field and have the know-how to properly evaluate that information, they provide us with good reasons for accepting or rejecting a claim.

When choosing an expert, we need to ensure that the person *is* actually experienced in their field; that he or she has a good reputation amongst his or her peers, and that it is a person with celebrated professional accomplishments. These factors most likely correlate with the intellectual qualities and experience that we expect from a true expert.

Yet again, we have to look out for biases and other judgement-distorting factors. For instance, is the expert motivated by financial gain or professional ambition? Does the expert hold austere or dogmatic political and religious views?

Conclusion

A common misconception exists that arguments ought to lead to an agreement, but what they actually aim to achieve, is consensus¹⁶ – that is, a complete shared faith in the outcome. A secure outcome can only be achieved with eloquent reasoning and the application of *first principle reasoning*.

We identified the two fundamental principles of an argument as (a) the *logical form*, and (b) the *truth of the supporting premises*. A *deductive* argument with a correct logical form is a *valid* argument, and if it is supported by true premises, it is called a *sound* argument. An *inductive* argument with a correct logical form is a *strong* argument, and when it is supported by true premises, it is called a *cogent* argument.

We have seen that the true mastery of ‘*the argument*’ requires a level of expertise and command over the argument pattern *as well as* the content of the supporting claims. These fundamental elements provide us with a *nexus* and combination of skills and techniques to help with the construction of good arguments with justifiable faith in the outcome.

We draw to a close with this statement by Camus:¹⁷

‘There are crimes of passion and crimes of logic. The boundary between them is not clearly defined.’

¹⁴ See the previous article, *The Elements of Logical Reasoning* in the May 2020 e-periodical, issue 3 edition of *Arbitrarily Speaking*.

¹⁵ The Bayesian method is invented by the English philosopher and statistician Thomas Bayes (1702 – 1761) and it provides a model to decide how readily we should accept an assertion (Levitan, 2017).

¹⁶ Heinrichs (2007)

¹⁷ This is the first line in the introduction of Albert Camus’s 1956 essay *The Rebel: An Essay on Man in Revolt*.

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