Introduction

The Very Idea of Critical Thinking

Critical thinking sometimes seems as if it needs an apology, or rather it seems itself to be a kind of apology, an apology for the humanities and the liberal arts and sciences generally. Having failed to convince many people that the liberal arts are simply good in themselves or in their own terms, academics sometimes seem as though they have concocted the meretricious idea of "critical thinking" in order to help higher education sell itself to the worlds of commerce, law, and politics. Instead of arguing that the liberal arts comprise some of the very best ways to spend a human life, period (and that we ought, therefore, to support them enthusiastically and share them as widely as possible), academics seem inclined to wave the flag of critical thinking to convince governments, parents, students, and donors that the liberal arts offer something that's "useful" or "profitable" in the "real" world.

Critical thinking also seems to appeal to administrators and the administratively inclined because it poses as something testable, as composed of skills that produce "measurable outcomes" readily subject to "metrics" and "assessment." Yielding measurable, quantifiable outcomes is important not only for demonstrating to those outside the academy the value of critical thinking and the liberal arts but also for "accountability," for oversight, for ranking and managing, and perhaps for policing liberal arts faculties.

There is truth in all this, embarrassingly so. But it's not the whole story about critical thinking (or the liberal arts), not by a long shot. The authors of this book are convinced that the family of practices collected under the rubric of "critical thinking" does indeed include some of the best and most important activities human beings have forged and re-forged, shaped and refined over the last three millennia. It's not too much to say, in our view, that critical thinking distills some of the very best of that inheritance. In the development of our sciences, our political institutions, and our very self-understandings, critical thinking has played a central role, and it's simply

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fine and good to pass on that treasure to future generations. What has been true of our history remains true today: strong critical thinking is not only useful for commerce, the law, and technology, it's absolutely crucial to a dynamic and thriving culture, and it defines an essential component of any solid education.

But what is critical thinking? What composes it? In this volume, we've taken a broad, interdisciplinary, and relatively comprehensive approach to critical thinking. While many critical thinking texts focus almost exclusively on logical topics, we've also compiled critical insights and practices that have been cultivated by the natural and social sciences, notably psychology, by literature and literary criticism as well as by the fine arts, and by political and social theories. We treat literature, rhetoric, and the arts not simply as obstructions or distractions that get in the way of clear, analytical, and logical thinking – though they sometimes can do that. We recognize in addition that the visual, literary, and generally rhetorical arts possess distinctive tools to enhance and deepen critical thinking. While the critical tools developed by philosophers, logicians, mathematicians, and empirical scientists are extremely important to good critical thinking, the critical instruments honed by theorists in literary, political, and social theory have been profound. No account of the possible methods of critical thinking available today would be respectable or even roughly complete without them. Arguments are, indeed, terribly important, but they're not by any means the whole story of critical thinking. We encourage readers, therefore, to take a similarly broad, interdisciplinary, and inclusive approach and to consider the diverse ways critical thinking has been cultivated across the spectrum of reflective human thought.

Critical thinking in the formal and empirical sciences

Considering the structure of this book, we begin with logic, since logic is basic and essential to critical thinking. Chapters 1–4 of this ten-chapter volume are accordingly devoted to explaining some of the most important critical tools logicians have crafted, especially for the practices of what they call *deductive* reasoning. These techniques can seem a bit daunting to beginners, but because logic is so important we encourage you to press on through them. Logicians have studied the *formal* qualities of deductive inferences over thousands of years, and they've produced several logical systems that critical thinkers can use to test arguments. Those tests are not only indispensable tools for critical thinking. They also share the virtue of producing definite answers about good and bad reasoning using procedures that are clear, reliable, and not terribly difficult to use.

The oldest of these systems we'll address (Chapter 3) was systematized first by Aristotle in fourth-century BCE Greece. It's come to be called *categorical logic* since it's a logic that's based upon categories of things. We'll map out seven tests for the validity of arguments using categorical logic. Those seven by themselves will provide critical thinkers with a rich and powerful set of tools to interpret and assess vast regions of human reasoning.

Yes, humans seem to possess a natural capacity for recognizing good reasoning even without studying critical thinking in a formal way, but the systems we present are important to master because they make it possible for skilled critical thinkers to build on that natural capacity and employ proven and useful rules in expansive ways – including articulating proper explanations and definitions, determining logical equivalences, and identifying contraries and contradictions, as well as a variety of other logical relationships. We'll explain and demonstrate the use of helpful pictographic tests using Venn diagrams and Gensler stars, and after setting out some basic logical theory we'll show you how to apply a number of simple procedures for reliably identifying valid and invalid arguments almost in a snap.

The second principal kind of formal logic we'll address (Chapter 4) has come to be called *propositional* or *sentential logic* – because, yes, it's the logic of propositions or whole sentences. These sections will present you with additional ways to test arguments, especially through what logicians call truth tables, common forms of valid argument, and tried-and-true rules of inference. Truth tables are attractive to people because they offer a graphical way of testing arguments, and one that's simplicity is perhaps even more exhaustive and direct than Venn diagrams. Learning the formal structures of the most common valid as well as invalid arguments together with what we think is an essential collection of other inference rules will help you sharpen the focus of your reasoning detectors so that the success or failure of arguments becomes much more easily recognizable.

Chapter 5 sets out a substantial list of some of the most common ways people go wrong in their daily reasoning. These common *informal fallacies* aren't failures of the formal or structural dimensions of arguments (the stuff of Chapters 3–4), but rather failures of another kind. Sometimes what goes wrong in reasoning isn't a matter of argument form at all but instead often involves psychological factors that yield quasi-inferences that pose as good reasoning but simply aren't. Sometimes, alternatively, the problem lies with the underlying concepts and assumptions behind a claim. Those concepts and assumptions can be irrelevant, confused, or simply false, and as we'll see they can really mess up your reasoning. Good critical thinking skills of the sort described in Chapter 5 have been designed to detect them, and there are many of them. Because some informal fallacies are particularly related to scientific thinking, we'll broach additional informal fallacies across the remaining text, especially in those chapters devoted more directly to inductive reasoning and the empirical sciences.

There are sadly, then, a lot of ways that reasoning can go wrong. The modern natural and social sciences were born from a struggle to deal with many of these kinds of error while simultaneously trying both to understand the world and to answer the philosophical challenge of *skepticism* – the idea that knowledge itself might not be possible. As a result of those challenges, scientists and philosophers of science developed important ideas regarding what counts in terms of empirical inquiry as good *explanation* and solid *justification*. We'll therefore examine what makes scientific forms of inquiry so strong, and we'll also look at how science can go wrong. Chapters 6–9 will draw lessons in critical thinking from the natural and social sciences as well as

from ongoing philosophical confrontations with skepticism. We'll examine how best to confront the epistemological challenges of skepticism, how to think well and critically about causal explanations and statistical claims, how to enlist scientific principles critically, how to think critically even about science itself, and we'll consider what science has learned about why human beings make errors. Critical thinkers should certainly be able to assess non-scientific claims using scientific rationality, but they should also possess some facility with assessing scientific claims themselves.

Critical thinking, critical theory, and critical politics

Human beings are linguistic beings. We communicate, reason, and criticize using language, and the critical theories developed by scholars in fields related to rhetoric, languages, and literature have gone a long way toward explaining not only how communication works but also how it fails to work – that is, how language and our human modes of expression themselves create, even require, the possibility of error, confusion, and misunderstanding. The meanings we wish to express are difficult to express. They're elusive and fragile and complicated. We all know this on some level, but critical thinkers must become especially sensitive to it. Narratives, poetic tropes, voice, and other rhetorical dimensions of texts, however, not only offer opportunities for error and distortion. They also yield indispensable ways of understanding our selves and our world. Chapter 10 is designed therefore to help you consider critically the rhetorical and semiotic dimensions of the world in whatever text you confront – and not just in a theoretical way. Like our other chapters, Chapter 10 offers examples and problems for you to use in putting these tools to work.

Human practices of expression are also tied up with political relations. We are, as Aristotle observed, political animals. Moreover, political theorists, especially across the past few centuries, have come to understand that politics doesn't only exist in the halls of government, in voting booths, on explicitly political Internet web sites, or on clearly political TV or radio talk shows. Politics is, rather, pervasive and infuses our ordinary language, our concepts, our conduct, indeed the very institutions that compose our societies and cultures broadly speaking. Engaging political as well as moral topics critically, therefore, may involve not only thought but also action.

Political action may be a matter of subversion and destabilization, of prising open spaces for new ways of life, and deconstructing what we determine needs to change. It may also, however, be about justifying and stabilizing values, principles, and moral claims – those that already exist and we think it important to keep, to protect, and to secure. In order for readers to engage their own political world more effectively, in addition to questions related to justification and values in Chapters 6–9 we also lay out tools drawn from political theory in Chapter 10. We don't presume the political theories we describe to exhaust the field of political thought, and we don't necessarily endorse them ourselves, but we do think these are among the most important critical approaches today, and it's necessary for able critical thinkers to gain some facility with them.

Strong critical thinkers, in sum, should be able not only to wield the tools of logic and science but also those that illuminate the complexities of language and communication as well as those that help confront, advance, or resist the principal forms of morality and politics at work in the world today. Critical thinking should not only be directed toward improved inquiry into questions of truth and falsehood but also into issues of meaning more generally as well as imperatives and possibilities of moral and political action.

Critical thinking, finitude, and self-understanding

There's something else. We wish to make it clear that critical thinking, like our book as a whole, is about self-understanding. It's part of that ancient project enshrined in the inscription on the temple at Delphi and in the liberal arts and sciences: "know thyself." Using critical thinking we produce critiques not just of arguments, data sets, propositions, and texts in the abstract. We also produce critiques that reveal our limits, our weaknesses, our finitude, and our selves as we actually exist in the world. Thinking about the world, about others, and about ourselves in light of a reflective and critical self-understanding of the human condition may be even more important than winning arguments or unreflectively accumulating facts, wealth, or power. It may, indeed, be the most important critical thinking outcome of all.

Using this book

This volume is not a complete text in logic, cognitive psychology, epistemology, critical theory, or political and social theory. The world of ideas is vast. We have collected what we think are the essentials for a basic grasp of critical thinking, and we have compressed, so far as possible, our entries to provide you with substantial and sophisticated but also concise accounts of the tools we address. You may read the text sequentially since it follows an arc from the positive establishment of claims through the complexities of logical and scientific thinking and reasoning to, finally, a critical *denouement* in rhetoric and politics. But the text may be read in other ways, too. You may start anywhere and either follow your own muses or fork off onto the network of paths we recommend using the suggested "See also" pointers at the close of most entries and chapters.

You will often see us referring in the body of the text to the preceding toolkits in this series: *The Philosopher's Toolkit* and *The Ethics Toolkit*. That's because we understand these books to work together synergistically with ours, and they often offer entries that complement and enrich our own. Some of the entries of this volume overlap with entries in those other toolkits (and we are grateful to Julian Baggini for permission to do that), and so together we think they offer a kind of functional whole of critical and philosophical thinking. But this volume stands on its own, too, very much so; and it offers readers a fine gateway all its own to these powerful, critical tools.

Our book also contains larders of examples and problems for study and exercise. These may be enlisted by instructors in their class preparation or simply by readers for further reflection. As we've not always provided answers to these problems and questions, they're as much matters of provocation as instruction. A list of web sites at the end of the volume suggests additional resources relevant to critical thinking freely available on the Internet.

Know thyself and think critically.

Basic Tools for Critical Thinking about Arguments

1.1 Claims

"Listen to reason!" cried Charlotte, exasperated after an hour of argument with Charles. And Charlotte's frustration may have been perfectly justified. What is reason? And why should we listen to it? Most basically, reasoning is about advancing *truth claims* by means of special *logical* procedures of *argument* (see 1.2). One of the most basic elements of critical thinking, then, especially when engaged with issues related to logic and science, is to discern whether claims are actually true and to distinguish them from claims that are not true.

In practice, language is our most fundamental tool in this process. Language allows us to articulate what we judge to be true or false, and it allows us to share and communicate those judgments to others. Ultimately, a good critical thinker must develop an acute grasp of language in order to make clear and precise claims about the truth and to assess how well or badly they function in the logic of an argument. Logicians have technical names for the kind of sentences out of which logical arguments are built. They call them *statements* or *propositions*, and they're simply sentences that can be either true or false (in logical terms, they possess a *truth value*). To really understand statements and their truth values, however, keep the following in mind.

- *Bivalence*. Statements or propositions can *only* have one truth value, and it must only be either true or false. Moreover, statements or propositions can't be both true and false in the same sense under the same circumstances. Logicians call this the principle *the law of bivalence*. (To be sure, there are multi-valued logics with values besides true and false, but again they're the subject of a different, more advanced book.)
- *Excluded middle*. There's no middle ground or gray area between truth values in basic logic – no "truthiness" as the comedian Steven Colbert might say. Statements or propositions can't be "sort of true" and "sort of false." Logicians call this

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requirement the *law of excluded middle*. (Yep, there are *fuzzy logics* that accept gray areas, but we won't be dealing with them here.)

- *Non-statements and propositions*. Keep in mind, too, that sentences that aren't (in logic's technical sense) statements or propositions simply don't have truth value. Neither questions ("Where are you going?") nor commands ("Stop that!") nor exclamations ("Wow!!!") are properly speaking true or false; and so they can't be proper parts of arguments, logically understood.

Now, the idea of a *claim*, in the sense we use the term here, adds for the sake of critical thinking just a bit more to what logicians strictly call statements and propositions. In particular, *claims* are statements that indicate a position has been taken. A claim, in other words, is a statement or proposition that in some meaningful sense sincerely belongs to whomever or whatever asserts it. One of the first judgments a good critical thinker must make, then, is to determine in just what way a statement is presented. Perhaps it's meant sincerely and seriously, but perhaps it's just being used hypothetically, ironically, as a joke, an instructive example, a lie, or perhaps in the recitation of some movie script. Or maybe it is simply being used to provoke an audience, to gain attention, to test someone's response, or perhaps for some other reason entirely. There are countless things one can do with words and other forms of expression. So, while most of the material in this and the next four chapters applies to all claims, and not just to statements or propositions, we will use the language of "claims" to keep the question of claim or non-claim in mind.

Here's the upshot. Since it's often the case that critical thinking involves discerning truth and error, a good critical thinker must learn how to identify claims that are true, or most likely seem true, while at the same time recognizing and avoiding claims that are best judged false. What's more, a good critical thinker will recognize and admit when he or she does not know whether a claim is true or false. Critical thinking sometimes requires reserving judgment as to whether or not a claim is true until, if ever, sufficient reason for determining the truth or falsity of that claim is discovered.

Beliefs and opinions

In the 1989 comedy film, *The Big Lebowski*, a competitor scheduled to face the main character, the Dude, in the next round of a bowling tournament declares that his team is going to crush the Dude's. The Dude, at least pretending to be unfazed, responds, now famously, by remarking, "Well, that's just your opinion, man." It's not uncommon for people to distinguish strong truth claims from those that are weaker by calling the weaker claims opinions. People often make claims such as, "The world is round," implying it's something we definitely *know* to be true, that it's a *fact*. When, on the other hand, people make claims such as, "Pele was a better athlete than Gretzky," we deflate the claim by saying that it's just their "opinion."

Beliefs can obviously often be either true or false, but a misleading though nevertheless common misunderstanding about the difference between strong assertions

(such as knowledge claims) and mere opinions is that opinions aren't really true or false. As such, they're often thought to be free from the same scrutiny and justification required by claims to *know*. The result of this mistaken view is that many people believe that one's opinions are somehow insulated from dispute or challenge. Opinions are treated as if they stand alone as islands in our thoughts, entirely disconnected from criticism and critical thinking. In reality, however, our opinions are still very much claims open to criticism. They are, after all, claims, and therefore either true or false. (Matters concerned with knowing are described as *epistemic*, and *epistemology* is the study of knowledge. Matters concerned with belief we'll sometimes call *doxastic*.)

In addition, it's important to understand that opinions are often influenced by what we value. This mixing of beliefs and values sometimes makes it difficult or confusing to assess their truth. But a good critical thinker's toolkit provides the tools for tackling this seemingly tricky task (see 5.5, 7.2, 8.2, and 8.5). In the meantime, just keep in mind that opinions often incorporate judgments and emotions about what is valuable, either subjectively, to the person expressing the opinion, or objectively, to everyone in the world.

Simple and complex claims

A *simple* claim is a claim that, logically speaking, isn't divisible into other, more basic claims. This is usually a single subject-predicate formula, for example, "It is a cat," or "That ball is round." A *complex* or *compound* claim is a claim logically composed of two or more claims (or, minimally, a single claim that's negated) connected by special words or ideas logicians call *logical operators* or *connectives*. (Of course, not all devices to connect one sentence with another do so as a matter of logic – as any poet or lyricist will tell you.)

Simple claims, as some logicians have observed, are kind of like atoms, while complex claims are kind of like molecules. The claim that "Earth exists" is a simple claim. If, however, we add to the claim that the Earth exists another claim, "Humans live on Earth," then we will have created the complex or molecular claim: "Earth exists, and humans live on it." Notice that a complex claim may be expressed in lots of ways, and yet still be composed of the same simple claims:

Humans live on Earth, and Earth exists.
Humans live on Earth, which exists.
Earth exists, and humans live on Earth.

Sometimes, two sentences, whether simple or complex, can be said to possess the same *meaning*. Having the "same meaning" can, however, mean a variety of things. In this context, let's just say that sentences having the same meaning can be used interchangeably, and one reason for this may be that the claims have the same *cognitive* or *material content*. (Another reason, as we'll discover in the next three chapters, may be that they have the same *formal* qualities, which means they have the same logical

structure.) The cognitive or material content of most claims determines the conditions that make those claims true or false – or what logicians call the *truth conditions*. In other words, the claim that the Earth exists is true if and only if the Earth really exists. The Earth's existing is the condition that must be met in order for the claim "Earth exists" to be true.

The truth conditions of complex claims, however, are a bit more, well, complex than those of simple claims. The truth conditions of complex claims are determined not only by the simple claims from which they are constructed but also by the *logical operators* or *connectives* used to combine the simple claims and sometimes other properties of the complex. Common logical operators are "and," "or," "if," "if and only if," and "not." (The last of these, "not," is unique and extremely powerful. It's not used to combine multiple simple claims, but rather to change the truth value of a claim, whether simple or complex, to its opposite value. If true, a negated claim becomes false; if false, a negated claim becomes true.)

Earth exists.	simple claim
Earth does not exist.	negation (not)
Earth exists, and humans live on it.	conjunction (and)
Earth exists, or humans live on it.	disjunction (or)
Earth exists, if humans live on it.	conditional (if)
Earth exists, if and only if humans live on it.	biconditional (if and only if)

Of course, each of these claims has a different meaning, and those meanings are derived from the cognitive content of the simple claims – "Earth exists" and "Humans live on it" – as well as from the logical operators that are used to combine or modify those simple claims.

Here's a tricky bit. It's important to remember that despite the number of simple claims composing a complex claim, a complex claim can be viewed as one, big single claim. That's because a complex claim is, as a whole, either true or false, just like a simple claim. The simple claims "Earth exists" and "Martians exist" have truth values (the first is true and the second, we presume, is false). But combine them into a complex claim using a connective and the result has its own truth value: the claim "Earth exists *and* Martians exist" is false; the claim "Earth exists *or* Martians exist" is true. You will see exactly why in Chapter 4. For now, just be aware that complex claims are single if not simple claims, and that each has its own single truth value.

Truth functionality

Here's something even a little trickier. The truth value of different kinds of complex claims must be determined in different ways. For some complex claims, the truth or falsehood of the whole is *completely* determined in a logical sense just by the truth values of the component claims that compose it as well as by the way they relate to one another – that is, by (1) the simple claims plus (2) the logical operators that connect

and modify them. For other kinds of claims, you can only determine the truth value of the whole claim by considering other features of the claim and perhaps only the claim as a whole.

When the truth or falsehood of the whole is *fully* determined by the truth values of its component simple claims plus their logical relations (the first type), we call the claim a *truth function* or say that the sentence is *truth functional*. There are lots of other simple and complex statements and claims, however (the second type), that don't possess this property. Belief statements, for example, are not truth functional. So, the truth value of the sentence, "Oedipus believes that the husband of Jocasta is not the killer of Laius," does not, tragically for Oedipus, depend upon the truth or falsehood of its component simple claim, "the husband of Jocasta is the killer of Laius." Unfortunately, whether or not we believe a statement is often independent of whether or not it's true. (The distinction between truth functions and non-truth functions may seem a bit arcane at this point, but truth functionality will become especially important later, and we'll elaborate on the concept a bit more when we address propositional logics in Chapter 4.)

SEE ALSO

4.1 Propositional vs. Categorical Logics
8.1 Knowledge: The Basics
9.5 Unfalsifiability and Falsification Resistance

READING

Patrick J. Hurley, *A Concise Introduction to Logic*, 12th edn (2015), Sections 1.1, 2.2, 6.2
Julian Baggini & Peter S. Fosl, *The Philosopher's Toolkit* (2010), Chapters 1–3
Anthony Weston, *A Rulebook for Arguments*, 4th edn (2009), I.1
J. van Benthem, *A Manual of Intensional Logic* (1988), Part I

1.2 Arguments

A well-known Monty Python skit presents two men at an "Argument Clinic," a client and a "professional" arguer. The fun begins when the professional arguer simply contradicts everything the client says ("Yes, I did." "No, you didn't." "Yes, I did." and so on.). Shrewdly, the client isn't impressed: "Look this isn't an argument … It's just contradiction." Okay, so what *does* count as an argument?

For critical thinkers, the term "argument" means something very specific. Briefly put, an *argument* is a special tool that systematically collects and arranges reasons in support of the truth of a claim. As the client of Monty Python's Argument Clinic

puts it, "An argument's a collected series of statements to establish a definite proposition!" A bit more specifically, arguments are simply sets of claims in which one or more claims are to provide support or justification or proof for the truth of another claim.

Essential to every argument, then, are at least two components: (1) a single *conclusion* and (2) at least one reason or *premise* for the conclusion to be true. Identifying which is which in a given case can sometimes be confusing, though. That premises are intended somehow to support or seem to support a conclusion indicates that a third element is present in logical argument – (3) an *inference* from the premise(s) to the conclusion. It's in the quality of that inference where things get especially interesting for critical thinkers, as not all inferences are good or strong or legitimate.

Logic vs. eristics

It's common for people to confuse verbal altercations with arguments, since commonly, the term "argument" refers only to a dispute between two or more people, any kind of dispute. It's also common for people to confuse *eristics* (the study of *winning disputes*) with *logic* (the study of *reasoning*). Arguments, however, in the technical, *logical* sense discussed here do not require a dispute, disagreement, or even dialogue, and they certainly don't involve yelling, screaming, fisticuffs, or kerfuffles of any other sort. Furthermore, *debates* are also commonly confused with arguments because they are typically composed of many arguments, and the opposing sides of a debate offer arguments in support of the claims they wish to establish. So, debates include argument, but you needn't have a debate to argue.

Arguments vs. explanations

Moreover, not all sets of sentences that lead to statements claimed to be true are arguments. For that reason, often a critical thinker will find himself or herself trying to determine whether or not a set of claims is, in fact, an argument. For example, *explanations* often seem like arguments. But there is deep difference between the two. Explanations are sets of claims that function to establish *how* or *why* something is the case. Arguments, in contrast, undertake to establish *that* some claim, normally a claim in question, is actually true. It's very different, for example, to explain *how* extraterrestrials have made their way to Earth from arguing *that* extraterrestrials have made their way to Earth – though both might involve presenting a flying saucer.

Arguments show that *something is the case.*
Explanations show how *or* why *something is the case*.

Explanations are easily mistaken for arguments because in many respects the two share stylistic similarities. Much like an argument, an explanation will include a single claim upon which all the other claims bear. In an explanation, this claim is called an

explanandum, and the remaining claims, called the *explanans*, are used to account for ("explain") the explanandum. Because an explanandum is a claim like any other, it is true or false. But an explanation is in no way concerned with establishing or supporting the truth of the explanandum. Instead, the truth of the explanandum is already accepted or presupposed. Often, explananda are easily identifiable because they're not controversial, or we have no obvious reason to doubt that they are true. Take, for example, the following set of claims:

> The speed limit on this road is 45 mph, except when school is starting or ending, at which time it drops to 25 mph. That's *because* during those times it's especially important to protect the school children.

The truth of the explanandum, "The speed limit on this road is 45 mph, except when school is starting or ending," is not at issue. The explanans merely attempts to make clear why this is so.

SEE ALSO

2.1 Deductive and Inductive Arguments
4.1 Propositional vs. Categorical Logics
6.2 Analogies and Arguments from Analogy

READING

Arthur Schopenhauer with A. C. Grayling, *The Art of Always Being Right* (2012/1831)
Ernest Lepore & Sam Cumming, *Meaning and Argument* (2012)
Miriam Joseph with Marguerite McGlinn, eds., *The Trivium* (2002)
G. B. Kerferd, *The Sophistic Movement* (1981)
Ernest Nagel, *The Structure of Science: Problems in the Logic of Scientific Explanation* (1979)

1.3 Premises

One clear difference between proper argument and mere contradiction (as well as most shouting matches) is that an argument depends for its strength upon *premises* functioning as *reasons* to accept the *conclusion*. Premises give an argument its heft, its strength, the ground upon which the conclusion stands. They work together in exacting ways to prove or demonstrate or justify the conclusion. Some arguments enlist only one premise (and every argument must have at least one premise). That seems obvious, since there must be at least one reason to accept the conclusion in order for

a set of claims to count as an argument. But that's just the minimum. It may seem odd, but maximally there is no limit on the total number of premises an argument can enlist. An argument may indeed require volumes of text to complete, containing a staggering number of premises, perhaps (though this is something of a matter of dispute) even an uncountable or infinite number.

Enthymemes

Often, an argument will contain implicit or unspoken premises, usually probable claims already accepted by the audience. Arguments of this sort are called *enthymemes*. Enthymemes, then, are informal arguments that rely on premises not explicitly articulated. (We'll see more of them in Chapter 3 when we consider Aristotelian or categorical arguments.) Since enthymemes are not uncommon, in order to assess the merits of arguments properly, a critical thinker will find it very helpful to look for enthymemes or enthymematic arguments and flush out their implicit or assumed claims. In short, sensitivity to enthymemes helps discern assumptions.

Identifying premises

Identifying the premises of an argument is made a lot easier by first identifying the argument's conclusion. Once the conclusion is identified, any remaining claims that are there to support the truth of the conclusion become easier to discern. There are, however, several caveats of which critical thinkers should be mindful.

First, it's not necessarily the case that all of the claims in any given text are used as premises. Many texts contain lots of pieces of information that play no logical role at all in supporting the truth of the conclusion. For example, some claims merely elaborate, highlight, clarify, or give examples in relation to one of the premises. Some sentences are there just for rhetorical purposes. Sentences of those kinds are not relevant to the logic of the argument, though they may be used to clarify or explain a claim or a term, or they may be used to make the argument flow more smoothly. And so the critical thinker will find it useful to set these aside when analyzing and evaluating the argument.

Second, as we've seen, claims may be complex. So critical thinkers will need to consider whether or not compound claims should be untangled and broken up. A complex claim may be easier to work with if it's broken up into separate claims. But be careful if you do this, because sometimes breaking up a complex claim can change its meaning, especially if you lose the effect of the logical operators.

Thankfully, good writers often set off premises and conclusions with indicators. *Indicators* are either single words or phrases that alert the reader or listener to the logic of an argument. (It's good, for that reason, to use logical indicators while writing or speaking. Your audience will thank you.) While it isn't necessary for an argument to contain these words, they do help to clarify an argument's structure. Words or phrases

that are specifically useful to indicate that a premise precedes or follows the indicator word are called *premise indicators*. Here are some of the most common:

since	because
given; given that	for; for the reason that
as; insofar as	due to the fact that
in that	it may be concluded from

For example: *It will likely rain today given that it's the rainy season and because the sky is full of thick, dark clouds.* In this argument, two reasons are given for thinking it will likely rain today, and both are preceded by premise indicators: *given that* and *because*.

Be careful, however, because some premise indicators perform other functions in our languages. The premise indicator word "since," for example, does not always indicate that a premise is nearby, because "since" is also used to indicate that a period of time has passed. ("I've lived in this same house since 1965.") Similarly, the word "because" may indicate a premise, but it may also indicate an explanans in an explanation (just as it does in the previous sentence, and also: "My house collapsed because of termite damage").

To be sure that the claim is a premise, a critical thinker must determine whether or not it functions as a reason to think another claim (the conclusion) is true. In an argument without indicators, a critical thinker must do this anyway, but the indicators make things easier by offering a shortcut to determining whether a given claim is best understood as a premise.

These two formulations of the same argument demonstrate how the presence of indicators clarifies the relationship of the claims in an argument:

1. Riley is a mammal at the National Zoo. Riley is an elephant at the National Zoo.
2. Riley is a mammal at the National Zoo, given that Riley is an elephant at the National Zoo.

In the first formulation of the argument, it is unclear whether the arguer is attempting to *prove that* Riley is a mammal at the National Zoo or instead perhaps just report that Riley is an elephant and a mammal at the zoo. Without the indicator words or phrases, readers can't be sure how the text is being used. Context can help, but sometimes context is insufficient. The presence of the indicator phrase in the second formulation of the argument removes this complication by making it clear that one of the two claims is intended as a premise and the other as a conclusion.

SEE ALSO

1.1 Claims
2.3 Classifying and Comparing Claims
3.4 Formal Deduction with Categories: Immediate Inferences

READING

Dan Cryan, *Introducing Logic: A Graphic Guide* (2004)
Harry J. Gensler, *Introduction to Logic* (2010)
Stan Baronett, *Logic* (2012)

1.4 Conclusions

The *conclusion* of an argument is the claim that the premises are to support or justify. In large part, the conclusion is the main point of the argument. If an argument were like a treasure hunt, the conclusion would be the treasure, and the premises would be directions presented to get you to that destination. Similarly, every argument has one and only one conclusion. While there may be important points that must be made on the way to establishing a conclusion, ultimately all the important points should work together to support one single claim. Even though a single argument could take a book or more to complete, it would still have only one conclusion.

Argument structure

Now, authors do often claim to draw multiple conclusions from their arguments. Sometimes that means that they draw subconclusions on the way to a final conclusion. It's also possible that the premises of the argument support the truth of multiple claims or a complex claim that can be broken into multiple claims.

In even the terribly simple argument below, a single premise supports two different conclusions.

P1. I have three buckets of apples.
C1. Therefore I have three buckets.
C2. Therefore I have apples.

Given the premises provided, the author could have also concluded that he or she has material objects or simply something rather than nothing. When multiple conclusions can be drawn from a single set of premises, it is best to think of each conclusion as the result of a single argument. This is often the best practice because keeping arguments distinct, even when they share premises, can help prevent confusions that lead us to error.

Simple and complex arguments

Arguments come in all shapes and sizes. One way to describe the form of an argument is, as with premises, in terms of *simple* and *complex*. *Complex arguments* are

arguments composed of two or more *simple arguments*. In a complex argument, the conclusions of simple component arguments become subconclusions in relation to the whole complex. As subconclusions in the complex argument, they also function as premises for the conclusion of the complex argument.

Identifying conclusions

As there are indicator words and phrases for premises, there are indicator words for conclusions as well. *Conclusion indicators* are words or phrases that alert the reader to the presence of the conclusion. Below is a list of commonly used conclusion indicator words and phrases:

therefore	it follows that; we may conclude that
hence	so; so that
thus	entails
implies	consequently

Conclusion indicators are fairly reliable indicators of conclusions; but just as it was with premise indicators, it's always important to check the claim indicated by the conclusion indicator to see if that claim is, in fact, the logical, final conclusion of the argument. It is not uncommon for conclusion indicators to mark the presence of a subconclusion in a complex argument. Context and the rules of logic will often clarify things, but it's notoriously difficult, especially in highly complex texts, to discern the arguments. In fact, when we get to Chapter 10 (especially in 10.5), to what's called the "semiological problem," we'll see that the very nature of language and interpretation ensures that this work remains difficult. That difficulty, indeed, is one of the reasons academic philosophers and other scholars remain in business!

Exercises and study questions

1. Determine whether the following claims are simple or complex:
   - Monday Night Football is the most widely watched television program in the United States.
   - If you go to the store, then please purchase some milk and eggs.
   - All the cars are vehicles with bad gasoline mileage.
   - Either the weather is going to improve, or we'll need to cancel the picnic.
2. Identify the premises and conclusion in the following arguments:
   - It's important that we respect the choices of others, and it's important that we help look out for the welfare of others. Consequently, we must ensure that the available choices for others are always ones that will benefit their welfare.

- The average age of cars on the road today is around 10 years. Since my car isn't going to last much more than 7 years, its construction is probably inferior to most cars on the road today.
- Most students haven't discovered what they want to do with their lives, and yet many schools want them to declare a major before setting foot on campus. It follows from this that a student's major should be lenient and flexible with the number of required courses, because inevitably students will take classes in a degree field that they may change after a short time.

3. How many conclusions can an argument have?
4. How many premises can an argument have?

SEE ALSO

3.4 Formal Deduction with Categories: Immediate Inferences
3.5 Formal Deduction with Categories: Syllogisms
4.2 Common Deductively Valid Forms
8.6 Justification: The Basics

READING

Merrilee H. Salmon, *Introduction to Logic and Critical Thinking* (2012)
Paul Herrick, *Introduction to Logic* (2012)
Anthony Weston, *A Rulebook for Arguments* (2009)

2 More Tools for Critical Thinking about Arguments

2.1 Deductive and Inductive Arguments

Bridges function properly when they are engineered with (a) strong materials and (b) a supportive structure capable of carrying the loads trucked across them. Arguments, curiously, function in a similar way. It's just that the material out of which arguments are built isn't concrete, steel, or stone. Instead, claims or statements function as materials for creating premises and a conclusion, and so the structure of arguments isn't physical, but logical. Nevertheless, without the right materials and without having them assembled in the right way, an argument will fail just like a poorly built bridge.

All arguments are intended to support the truth of their conclusions, but arguments can be structured in vastly different ways to achieve this goal. Similarly, two bridges built alternatively with concrete and steel may look and work in vastly different ways, like arch bridges and suspension bridges, for example. Regardless of their apparent differences, though, if they're done right, if they have the right structure, they'll still support a road along with the vehicles that drive over it.

For arguments, it's the logical structure that matters, and that structure determines the extent to which the argument will be what philosophers call *truth preserving* — that is, the degree to which reasoning from true premises ensures a true conclusion. It's actually a pretty instructive term, since it captures something of the essence of what makes good arguments work, as well as the essence of what argument is about. In a good argument, true premises are worded and organized in a way that guarantees or makes it very likely that the conclusion is true; truth is *preserved* through the inference.

Another way to think about this is to imagine that the truth of the premises in a good argument flows into the conclusion. The key to this amazing process (and this is important!) is the argument's structure or *form*, and as such, assessing an argument's form is a critical component for evaluating the overall success of the argument.

The Critical Thinking Toolkit, First Edition. Galen A. Foresman, Peter S. Fosl, and Jamie C. Watson.

For this reason, arguments are categorized according to their forms and the extent to which they are truth preserving.

Deduction

Consider this: there are two ways an argument can be poorly engineered: (1) one or more of the premises – the materials out of which the argument is built – is false, or (2) the structure or form of the argument fails to provide adequate support for the conclusion. Of course, arguments whose forms, when functioning properly, are *fully* truth preserving are the strongest sort. They are called *deductive arguments*. When a deductive argument is properly structured, the argument is said to be *deductively valid*. When a deductively valid argument has true premises, it is called a *deductively sound* argument. In a deductively sound argument, the truth of the conclusion will *necessarily* follow from the truth of the premises. The idea has its roots at least as far back as Aristotle, who writes in the *Prior Analytics* (*Prior Analytics*; Book I, Chapter 2, 24b18–20), the fundamental text in the systematic study of deductive reasoning:

> A deduction is speech in which, certain things having been supposed, something different from those that are supposed results *of necessity* because of their being so.
>
> [*Editors' emphasis.*]

There is among philosophers, however, some controversy about what "necessarily" or "of necessity" means in the context of logic. So, one might say instead more cautiously that the conclusion of a valid deductive argument will "definitely follow," "is sure to follow," or "certainly follows." That's just to say, of course, that the truth of the conclusion is entirely supported through the argument's structure and by the truth of the premises. Another common way to put this is to say that a properly structured deductive argument is constructed so that it is *impossible* for the conclusion to be false *if the premises are true* (if the premises aren't all true, all bets are off). That impossibility is central to the way, as we'll see, a lot of critical thinking about reasoning works. Of course, when an argument is not fully truth preserving, when the truth of the premises doesn't entirely guarantee or ensure the truth of the conclusion, the argument is *deductively invalid*.

Deductive reasoning is pervasive in the sciences and in our lives generally. Deductive arguments are common in mathematical reasoning, for example, and they are the kind of arguments that compose the core of computer programming. Generally speaking, however, the arguments people encounter are not usually formulated in the precise, deductively valid forms logicians prefer. Logicians clean things up, but not without some risk. While the practice of carefully recasting an argument so that it is clear and deductively valid can be extremely useful, there is some risk that the result won't quite be relevant to what actually concerns people in a particular context. (We'll address something of what logic can miss or lose when we address matters of rhetoric and poetics in Chapter 10.)

Induction

There are many perfectly good arguments that aren't deductive. These arguments do not guarantee their conclusions, but they do give them enough support that they should be taken seriously. Arguments that are not fully truth preserving but whose conclusions nevertheless follow with a degree of probability are what logicians call *inductive arguments*. The truth of the conclusion of an inductive argument always goes beyond the support of the premises to some extent, and so the extent to which the argument is truth preserving – its *strength* – depends upon the degree to which the premises support the conclusion. *Inductively strong arguments* are arguments structured such that the truth of the premises makes it very *likely* that the conclusion is true. *Inductively weak arguments* are arguments in which the truth of the premises does not lend much support to the conclusion.

Of course, all this is a matter of degree, and so calling an inductive argument "weak" or "strong" may change with context. Normally, calling an inductive argument "weak" just means that, in terms of the case at hand, there is not enough support for the conclusion – in other words, that it would be unreasonable to accept the conclusion based solely on the premises. Most scientists engaged in inductive reasoning require a probability of 95% or more before accepting a conclusion as reasonable. The contexts of civil and criminal law, however, employ different standards of strength. In our day-to-day lives, a better than 50% chance of rain may be enough for us to conclude that we should carry an umbrella with us.

Be careful, though. A deductive argument may contain premises that make probability claims yet still be a deductive argument. Remember that it's not the content of the premises but the way they're related to one another (their structure), the kind of inference they make, that determines whether or not an argument is best understood as deductive. For example, even though the following argument involves claims about what's more or less probable, the structure of the argument is actually a well-established *deductive* form of inference called *modus ponens* (as we'll see in 4.2):

1. If tomorrow's game is a home game that will be played on a sunny day, then our team faces above-average chances of winning.
2. Tomorrow's game is a home game that will be played on a sunny day.
3. Therefore, our team faces above-average chances of winning.

While this may seem a bit confusing, here's the point. When thinking critically about an argument, it's often the case that, after identifying a conclusion and premises, the most pressing order of business is a bit of categorization, beginning with figuring out whether the argument is inductive or deductive. While this can prove tricky at first, as with most things it just requires some practice to get familiar with these categories. Ultimately, once the argument's structure has been figured out, the proper criteria can be used in order to decide whether you're dealing with a *valid* or *invalid deductive argument* or, instead, a *strong* or *weak inductive argument*.

SEE ALSO

1.2 Arguments
1.4 Conclusions
6.1 Inductive vs. Deductive Arguments Again

READING

Merrie Bergmann, James Moore, & Jack Nelson, *The Logic Book* (2013)
David Papineau, *Philosophical Devices: Proofs, Probabilities, Possibilities, and Sets* (2012)
W. V. O. Quine, *Elementary Logic*, revised edn (1980)
Fred R. Berger, *Studying Deductive Logic* (1977)
Aristotle, *Prior Analytics* (fourth century BCE)

2.2 Conditional Claims

When Sammy told her kids that, "If it rains, we'll go to the movies," she was making a conditional claim. A *conditional claim* is a type of complex claim in which the truth of one claim (the *consequent*) somehow depends upon or is contingent upon the truth of another claim (the *antecedent*). You might say that in a conditional claim, the consequent is true when the antecedent is true.

Conditional claims are often articulated in the form "if *p*, then *q*," where *p* and *q* can themselves be either simple or complex claims. For example, "If Barack Obama is president, then the United States has a Democratic president," is a conditional claim composed of two simple claims: (1) Barack Obama is president, and (2) the United States has a Democratic president. In the common "if *p*, then *q*" form, *p* is the antecedent and *q* is the consequent, and so for the current example "Barack Obama is president" is the antecedent, while "the United States has a Democratic president" is the consequent.

You may have noticed that our definition of "conditional claim" is broad. That's intentionally so because for logicians there's a pretty large range of what "depends upon" or is "contingent upon" might mean.

> *In the minimal sort of relationship between antecedent and consequent, a conditional claim asserts simply that when the antecedent is true the consequent is also true.*

Basic logical systems use only that minimal relationship. That means it's possible to accept a conditional statement as true simply when the consequent and antecedent are true as a matter of mere coincidence. For example: "If the Martian moon Phobos is behind the planet Mars, then somewhere on Earth someone is breathing." Since the location of Phobos has nothing to do with the fact that at this point in time people

are always breathing on Earth, this conditional statement is true simply as a matter of coincidence. Of course, the connection between the truth of the antecedent and the truth of the consequent may be stronger. There may even be a causal connection: "If you throw that match into that puddle of gasoline, it will catch fire." Alternatively, there may also be a kind of logical connection between an antecedent and its consequent: "If something is red, then it has color" or perhaps "If you add 7 to 5, then the result is 12." There are many relationships that can be captured by a conditional claim.

In fact, a rather important relationship for critical thinkers to remember is the one between premises and conclusion. The relationship between the premises and the conclusion of a deductively valid argument may be expressed through a conditional claim, and among logicians a conditional claim is often used to describe this relationship: "If the premises are true, then the conclusion is true." The relationship here actually has a special name. Valid deductive arguments are conditional claims where the antecedent (the premises) is connected to the consequent (the conclusion) in a particular, logical way called *entailment*. This issue quickly becomes philosophically complex and contested, but as a matter of common usage, it's safe to say that one claim or idea entails another when there is a deep, internal, logical, or conceptual connection between them. (See *The Philosopher's Toolkit* 4.8, "Entailment/Implication.") For example, the claim "Bob is a bachelor" entails the claim "Bob is an unmarried man."

A unique and important feature of conditional statements is that they only proceed in one direction. In the conditional statement "If Barack Obama is president, then the United States has a Democratic president," we know from Barack Obama's being president that the United States has a Democrat as president. You can't, however, run the inference in the other direction. We can't on the basis of this conditional infer from the fact that the president is a Democrat that he is Barack Obama. In "if *p*, then *q*," the truth of *q* follows from the truth of *p*, but the truth of *p* does not follow from the truth of *q*. (Doing so would be what's called the fallacy of "affirming the consequent" or an "illicit conversion." We'll address that and other errors that arise from not understanding conditionals in 3.4 and 4.5.)

Necessary and sufficient conditions

Another way to think about the relationship between the antecedent and consequent of a conditional claim is in terms of *necessary and sufficient conditions*. A *necessary condition* is a state of affairs that must occur for another state of affairs to occur. For example, the presence of breathable oxygen is a necessary condition for humans to live, which means humans must have breathable oxygen in order to live. Written in terms of "if *p*, then *q*," the claim "Breathable oxygen is a necessary condition for humans to live" becomes "If humans are living, then breathable oxygen is present." Therefore:

> *The consequent of an "if… then… " statement is the necessary condition for the antecedent.*

It is common to put the necessary condition mistakenly in the antecedent of the conditional claim, but thinking about the logic of conditionals can help clear things up. In a conditional statement of the form "if *p*, then *q*," we know that the truth of *p* is claimed to correlate with the truth of *q* – that is, a true *p* is claimed to imply that *q* is also true. Keeping this in mind and applying it to the claim, "Breathable oxygen is a necessary condition for humans to live," it should be clear that the presence of breathable oxygen does not result in humans living. Humans need more than just breathable oxygen to live, and so the presence of breathable oxygen alone is not enough to know that humans can live. After all, humans need food, water, and an environment that isn't too hot or too cold as well. There is, for example, breathable oxygen in a hot pizza oven, but that doesn't mean humans can live there. So, while breathable oxygen is necessary for humans to live, it is not the only condition that needs to be met for humans to live.

Necessary conditions are often indicated by the phrase "only if," one of the most powerful phrases, logically speaking, in any language. (Note that there are other ways to indicate necessary conditions, too.) It's quite different for Sammy to say to her children "We'll go to the movies *if* you clean your rooms" from "We'll go to the movies *only if* you clean your rooms." In the first instance, there might be other conditions under which the family goes to the movies – perhaps if the kids persuade her, perhaps if a friend calls and asks, perhaps if it snows or rains. In the second instance, however, the phrase "only if" establishes an exclusive condition that must be met, without which the antecedent won't be true.

> *The component statement designated by the phrase "only if" is the* necessary condition *of a conditional claim.*

Necessary conditions are powerful claims, because they are very strict in their demands. Although, that's not the only way to be logically powerful, as we'll see with another kind of condition.

A *sufficient condition* is a condition that when met is *enough* to know that some other condition has also been met. More strongly put, its truth (in a true conditional) assures that the consequent is also true. In Sammy's first sentence ("We'll go to the movies *if* you clean your rooms"), the children's cleaning their rooms is enough to assure them that they're going to the movies. Sammy's second formulation, however, the one that makes the children's cleaning their rooms nothing more than a necessary condition for going to the movies ("We'll go to the movies *only if* you clean your rooms."), does not give the kids a guarantee that if they clean their rooms they'll go. Meeting a condition stated in the consequent doesn't guarantee the antecedent, and that's because it's merely a necessary and not a sufficient condition.

Here's another example. A blackmailer who says, "I'll not go to the police with the incriminating information I have about you only if you give me the money," has not said that giving him the money will result in his not informing the police. In other words, he has not said, strictly speaking, what will happen *if the money is paid*. The blackmailer has made the much more limited claim that *if the money is not* paid he will

inform the police. Paying the blackmailer is necessary for his not going to the police, but it's not sufficient to guarantee it. His threat is consistent with his later demanding still more money or with going to the police anyway. That's one reason blackmail – and cleverly constructed conditionals – can be so maddening.

The antecedent of an "if … then … " statement is the sufficient condition *for the consequent.*

Similarly, the presence of human life in our example is *enough* to know that there is breathable oxygen present. As a result, the presence of human life is a sufficient condition for the presence of breathable oxygen. Of course, this does not mean that human life somehow *causes* the presence of breathable oxygen. The relationship between antecedent and consequent in that example is not causal. Again, conditional claims, simply by being conditional claims, do not imply any particular type of relationship between the antecedent and consequent, causal or otherwise – and so neither do statements of necessary and sufficient conditions.

Biconditional claims

A *biconditional claim* is a complex claim that expresses a relationship of equivalence between two claims. Two claims are considered *equivalent* in this logical sense, when they always have the same truth value (that is, they are both true or both false). The claim, "Suzy will get a raise if and only if she gets a promotion," uses the connective phrase "if and only if" to denote the biconditional relationship between Suzy's getting a raise and Suzy's getting a promotion. When a biconditional is used to connect two claims, it means that one claim will not be true without the other claim also being true – and one claim will not be false without the other claim also being false. In Suzy's case this means four things: (1) if she gets a raise, then she also gets a promotion, *and* it means (2) if she gets a promotion, then she also gets a raise. Moreover, (1) if she doesn't get the promotion, she doesn't get the raise, *and* (2) if she doesn't get the raise, she doesn't get the promotion. The conjoining of these two conditional claims explains why it is called a "biconditional," that is "two" conditionals in one claim.

Like a conditional claim, the biconditional expresses a relationship of implication between two claims, but unlike a conditional claim, the biconditional's implication relationship extends to both of the claims composing the biconditional. Written in terms of claims *p* and *q* the biconditional "*p* if *and* only if *q*" is the same as saying, "if *p*, then *q and* if *q*, then *p*," because not only does *p* imply *q* for the biconditional, *q* also implies *p*. Logicians commonly abbreviate this "if and only if" or biconditional relationship with "iff."

In terms of necessary and sufficient conditions, a biconditional claim describes a relationship between two claims such that each individual claim is both necessary and sufficient for the other. For Suzy, this means that getting a raise is both necessary and sufficient for her getting a promotion, and so Suzy can't have one without the other. She will either get a raise and a promotion, or she will get neither. Claims that are

both necessary and sufficient come as a package deal, committing whomever advances those claims to accepting both or neither.

Biconditionals are also helpful in critical thinking about concepts, as definitions are often couched as biconditional relationships. For example, a definition of "justice" is a good one if and only if it describes situations that are just or are called "just." If, therefore, we come across a situation that we accept as just but that doesn't fit the definition under scrutiny, then that definition must be somehow inadequate. And if we discern a situation that we identify as unjust but that does fit the definition of justice we're examining, then similarly that definition fails. Philosophers and other critical thinkers often use this strategy to criticize definitions and to clarify concepts.

SEE ALSO

4.5 Common Formal Fallacies
6.3 Fallacies about Causation
9.4 Scientific Method

READING

Michael Woods with David Wiggins, eds., *Conditionals* (2003)
Jonathan Bennett, *A Philosophical Guide to the Logic of Conditionals* (2003)
Julian Baggini & Peter S. Fosl, *The Philosopher's Toolkit* (2010)
Graham Priest, *Logic: A Very Short Introduction* (2000)

2.3 Classifying and Comparing Claims

When thinking critically, it can be helpful to consider the kinds of claims with which one is dealing, especially the way those sentences relate to truth. Logicians have come up with a number of ways of understanding the truth-bearing qualities of claims and other statements both by (a) comparing them and by (b) categorizing them into types.

Comparing claims

Here are four of the principal ways logicians compare statements with one another. (Note that some of them overlap.)

1. *Consistency.* For critical thinking, consistency is one of the most important virtues. So much so, in fact, that those who pride themselves on being good critical thinkers are likely to meet the charge of inconsistency with the utmost indignation. It's a serious charge. The power of consistency in argumentation has a very long history. Socrates (469–399 BCE) in the Platonic dialogues, for example, often ferreted

out inconsistency in the remarks of his interlocutors, much to their chagrin. Even in defending his own life in *The Apology*, Socrates depended on pointing out the inconsistency of his accusers, specifically Meletus. On a far grander scale, in the *Book of Job* from the *Old Testament*, Job questions God's consistency after being allowed to suffer both mental and physical trials for what seemed to Job to be no apparent reason (e.g., Job 10:3). For a devout servant and worshiper of God, Job's suffering seemed inconsistent with what he knew of God's character. While it wasn't an overt accusation of hypocrisy (a logical vice, you might say, when one's actions are inconsistent with one's claims about appropriate actions), Job's remarks were nevertheless an accusation that God did not take lightly.

Very roughly speaking, consistency is about things fitting together in a way that makes sense. Both Socrates and Job were wrestling with situations that did not fit together in ways that made sense to them, and they were both very deeply concerned about it. Of course, their concern with inconsistency was partly a function of how it was about to affect or had affected their lives. Nevertheless, their situations may have been more bearable had they not appeared to be the result of obvious inconsistencies. Good critical thinkers, in any case, are adept at recognizing inconsistencies wherever they may appear; and what's more, they are tenacious about limiting or eliminating them in their own beliefs.

> *In logical terms*, consistency *is a term used to describe a set of claims that can all be true at the same time.*

Inconsistency. This occurs within a set of claims when it is *not possible* for all of the claims to be true at the same time. Maintaining a set of beliefs that is inconsistent means holding onto some beliefs that must, as a matter of logic, be false, which is why a good critical thinker is loath to hold an inconsistent set of beliefs.

2. *Contradiction.* A *contradiction* occurs between two claims when the truth of one necessitates the falsity of another, *and* the falsity of one necessitates the truth of the other. In short, contradictions occur when for logical reasons two claims must have *opposite truth values*, and so one must always be false while the other is true. Contradictory statements can never have the same truth values at the same time. For example, the claim, "All humans are mortal," stands in a contradictory relationship with the claim, "Some humans are not mortal." If "All humans are mortal" is true, then "Some humans are not mortal" must be false. And supposing that "All humans are mortal" is false, then "Some humans are not mortal" must be true.

Note that any set of claims containing a contradiction is inconsistent, since it could never be the case that the contradictory claims could be true at the same time. As a result, the set of claims containing a contradiction will always contain at least one falsehood, which is what makes it impossible for all of the claims to be true at the same time. Contradiction, however, is not the only form of inconsistency, as we'll soon see.

3. *Contrariety.* Contraries are also inconsistent. Contrariety is a relationship between two claims that occurs when at least one of the claims must be false, and

as a result it is impossible for both claims to be true at the same time. In contrast to contradiction, the relationship of contrariety does allow for cases where both claims are false at the same time, since the simple rule of contrariety is just that at least one (and maybe both) of the claims must be false. The claim "Tomorrow is Friday" is contrary to the claim "Tomorrow is Wednesday." Either of these claims might be true, but at least one of them is false, and both are false, for example, if tomorrow is Thursday. Contrariety, of course, makes creating a consistent set of claims impossible, because at least one of the two claims that are contrary to one another must be false. Therefore, a set containing contrariety will always contain at least one false claim, making it inconsistent. So, both contradictions and contraries yield inconsistent sets of statements.

4. *Equivalence.* Equivalence describes a relationship between two claims that always have the *same* truth value. If one claim is true and equivalent to another claim, then the other claim must be true as well. Alternatively, if one of two equivalent claims is false, then the other must be false as well. (The equivalence relationship is, as we saw in 2.2, described by the biconditional.) Common examples of equivalent claims occur when two claims mean the same thing but are expressed in different ways. "Friday is the best day of the week" is equivalent to saying "The day after Thursday is the best day of the week," since, logically speaking, both claims have the same meaning.

Classifying single claims

Here are three useful different categories of claims and other statements logicians have identified in terms of their possibilities of bearing truth.

1. *Contingent statements.* Contingent statements, by far the largest class in natural human languages, are simply statements that can be either true or false. More precisely, they are statements that are possibly true or false. So, the statement, "George W. Bush is president of the United States," can be either true or false, depending upon what year it is. Note that even while Bush was president, the statement remained a contingent truth. This is so because it was possible for Bush to have lost the election that led to his taking office. For a statement to be contingent all that's required is that it is *possible* that in some circumstances it is true and in some other *possible* circumstances it is false. There must be, as metaphysicians like to say, a logically *possible world* in which Bush did not win election to the US presidency. If, for example, Gore had won Florida, things would have turned out differently. One easy way, then, to identify a logically contingent statement is to consider whether its negation is a self-contradiction. No contingent statements have negations that are self-contradictory, because it's logically possible for every contingent statement to possess the opposite truth value from the one it happens to have. Self-contradictions don't work that way.

2. *Self-contradictions.* Self-contradictions are different from contingent statements because under all possible circumstances they always possess the same truth

value – false. Self-contradictions are also always equivalent to one another, of course, because they have the same truth value. It follows from this, if you think about it, that while all self-contradictions are equivalent, none are consistent. In fact, none are consistent with any other statement. That's because, obviously, there can never be a set of self-contradictions or set containing even a single self-contradiction of which all are true – which is what the definition of consistency requires. "This year is 2016, and this year is not 2016" is an example of a self-contradictory statement since no matter what year it is the sentence is false. A typical form of self-contradiction is "*p* and not-*p*."

3. *Tautologies.* There's another class of sentences, *tautologies*, which like self-contradictions always have the same truth value in all possible worlds and, moreover, are always equivalent to one another. In the case of tautologies, however, that's because they're always true. In this sense, tautologies are just the opposite of self-contradictions. "This year is 2016, or this year is not 2016," is an example of a tautology, since no matter what year it is the sentence is true. A common form of tautology is "*p* or not-*p*."

SEE ALSO

3.4 Formal Deduction with Categories: Immediate Inferences
4.3 Equivalences
9.5 Unfalsifiability and Falsification Resistance

READING

David Kelley, *The Art of Reasoning*, 3rd edn (2013)
Deborah J. Bennett, *Logic Made Easy* (2004)
M. J. Cresswell & G. E. Hughes, *A New Introduction to Modal Logic* (1996)

2.4 Claims and Definitions

Some words and ideas seem pretty easy to define. A bachelor is an unmarried man, for example. Some seem a bit harder. A square is a two-dimensional, equilateral, closed, four-sided rectangle. Still others seem all but impossible to define, perhaps because definitions in those cases are in fact impossible. How would you define goodness, or beauty, or justice, or being? Critical thinking, however, often depends upon a sensitivity to the meanings of words and therefore to matters of definition. Claims, as we've discussed, are assertions about what is true or false, but claims would be vacuous if the words that composed them didn't have specific meanings. If you think of all the words you've acquired as books filling the library of your mind, then definitions function like rules for organizing that library by bringing precision and clarity to the concepts

related to each word. Definitions tell us what bits of information belong together, and how categories of information relate to one another.

Lexical, stipulative, ostensive, and negative definition

Dictionaries are, of course, relatively good resources for anyone interested in finding out what a word means. Using one set of words to define another word is called a *lexical definition*. But it's important to understand the limits of dictionary definitions. More often than not, a definition in a dictionary requires readers to have a fairly robust understanding of the language already at their disposal. In other words, a dictionary functions in many cases as a cross-reference or translator between words one knows and words that one doesn't yet know. Even the most obscure words in a dictionary, say, for example, "pulchritudinous" or "kalokagathia," must be defined using words that the reader already knows and understands. Otherwise, the dictionary isn't very helpful. Another potential problem with dictionaries is that they often simply report on the way a word is commonly used, which can nevertheless be conceptually problematic and can change significantly over time. Critical thinkers and other inquirers, in contrast, are often interested in more precise, more accurate, and often more enduring definitions; and so sometimes a new or more precise meaning for a term is simply stipulated in what's called, obviously enough, a *stipulative definition*.

The word "friend," for example, is used in many ways and many contexts, but the question as to what is the best definition of "friend" may require moving beyond common usage to a more critical analysis of the concept. Similarly, the word "valid" is often used to describe claims made in common parlance ("You make a valid point."). But as we've discussed in 2.1, the word "valid" in logic has a very specific meaning and applies only to arguments; it does not apply to claims or points. Becoming a good critical thinker, then, requires distinguishing how words are commonly used from the way they are used in more precise contexts.

Sometimes, however, things get even more complex. There seem to be words that may be defined not through other words but only by pointing to something in our experience, through what's called *ostensive definition*. "Red," for example, may be impossible to define without somehow pointing to an instance of red. Individual things may be impossible to define, too, as individuals – though it's certainly possible to *describe* them or *name* them. Could anyone perfectly define you?

In addition, there are *negative definitions*. While it's generally a poor practice to define things negatively, by what they are not rather than by what they are, the medieval Andalusian Jewish philosopher Maimonides (c. 1135–1204) thought that humans could understand God only by articulating what God is not. Positively speaking, according to Maimonides, the human mind just can't apprehend God.

Extension and intension

The *extensional meaning* of a concept is just the set of things objectively picked out by the concept. So, the extension of the concept "dog" would be all those things in

the world that are properly picked out by that concept. Refining the definition (as well as the concept of "dog") expands or contracts that extension. Should it include coyotes? Wolves? Hyenas? A good definition should get the extension of a concept just right, not casting it too broadly or too narrowly. It does that by articulating criteria for including or excluding candidates from the term or concept's extension, or from the class or category it designates. We might call devices for determining what is properly included or excluded from a class or group or category *criteria for class membership*. A related idea is *denotation*. What a term *denotes* is its most literal, direct, or apparent meaning. By contrast, the *connotation* of a word, or what it *connotes*, are meanings that are oblique, more figurative, and associated less obviously with it.

The *intensional meaning* of the concept, by contrast, is just what people think or believe or otherwise subjectively take a concept to mean or refer to. In the past, people meant something different by the terms "morning star" and "evening star" in an intensional sense, even though the extension of those terms turned out to be one and the same object – namely, the planet Venus. Good critical thinkers, therefore, should aspire to having the definitions of the substantive terms they use match as closely as possible their true extension. (We know that this can get complicated, but be patient. Its importance will become clearer once we get to Chapters 3 and 4. For a bit of background on this topic, see *The Philosopher's Toolkit* entry, "Sense and Reference.")

Generic similarities and specific differences

Definitions often accomplish their task of setting the proper boundaries among concepts and tailoring terms to their proper extension by situating them among broader but interlocking, containing terms. So, for example, Aristotelians commonly defined human beings as rational animals. "Animal" is a broader term than human, and often called the *genus* term in a definition. "Rational" here establishes what's commonly called the "specific difference" or *differentia*, which indicates what essentially or distinctively sets off humans from other animals. (Of course, this definition of human being has for a long time been rather successfully challenged, but you get the point.) Biologists define organisms in a similar way using a strategy that runs all the way back to Aristotle's *Categories* – that is, by nesting them in an extensive series of increasingly general concepts: kingdom, phylum, class, order, family, genus, and finally species.[1] Now, that's probably a more precise definition than needed for most purposes, but it does exemplify how situating a term or concept among what is more general and more specific, that is, among its similarities and differences in relation to others, can be used to define it.

Definiens and *definiendum*

On a more practical level, in a way analogous to explanations (1.2), every definition has two parts, the *definiendum* and the *definiens*. The definiendum is the word or

concept to be defined, and the definiens are the words and statements that identify the genera and differentia for the concept. When definiens fail to articulate criteria for class membership such that it is unclear whether particular examples belong or don't belong to the class or extension, then the definiens are considered *vague* (see 5.13). Clearly, if you'll pardon the pun, a definition should clarify rather than obscure what it's defining.

If, for example, you tried to define coffee cups as "containers from which coffee may be drunk," you might meet some resistance in the face of 20 oz. bottles of coffee. They are, after all, containers from which coffee may be drunk, but it seems wrong to call them coffee cups. The definition seems inadequate because its definiens are too broad. You might also wonder about shoes. Coffee can be sipped from shoes, but certainly they're not cups either. The idea of container just seems too vague.

Concepts with vague or ambiguous definiens should always be clarified if the context of usage isn't sufficient for identifying the intended meaning. This process of clarifying a concept is quite common in the judicial system, where entire court cases hinge on how one defines a concept, like "pornography," "fighting words," "speech," "corporation," "cruel and unusual," "press," "tax," "harassment," "consent," "penalty," etc. To argue effectively and to think clearly, it's crucial to gain facility with the tools of scrutinizing and formulating good definitions.

SEE ALSO

3.4 Formal Deduction with Categories: Immediate Inferences
4.1 Propositional vs. Categorical Logics
10.5 Semiotics: Critically Reading Signs

READING

David Kelley, *The Art of Reasoning*, 3rd edn (2013)
Richard Robinson, *Definition* (1962)
Julian Baggini & Peter S. Fosl, *The Philosopher's Toolkit* (2010)

2.5 The Critical Thinker's "Two Step": Validity and Soundness/Cogency and Strength

Ok, we're on our way. A critical thinker cannot properly evaluate an argument without first identifying the parts of the argument and how they are meant to fit together. We've now acquired the resources to begin doing just that. The process of analysis begins by identifying the premises and conclusion, by clarifying the definitions of terms, as well as by determining whether the argument is deductive or inductive. Only after all that's

been accomplished should critical thinkers move on to evaluating the argument – its structure or form and whether it actually does justify some truth claim.

Structure before truth

It's important to understand that the purpose of evaluating any argument is not typically in the first place to assess whether its conclusion is true but rather to determine whether or not the premises provide *adequate support* for the conclusion. Again, what we're after is a process to evaluate the argument taken as a whole, and not merely an attempt to determine whether the conclusion or any individual premise is true by itself. It's crucial to remember this because as strange as it may sound *a flawed argument may still possess a true conclusion*. The process of evaluating the argument may demonstrate that the argument has failed to *support* the truth of that conclusion even while accepting that the conclusion is true. In that case, a better argument must be constructed to demonstrate that there are good reasons for justifying the conclusion as true.

Let's start, then, with a simple two-step procedure for argument analysis. We call this procedure the critical thinker's "two step":

Step #1: Determine whether or not the premises support the conclusion. If they do, go on to Step #2; if they do not, proceed no further.
Step #2: Determine whether or not all of the premises are true.

This procedure shows that there are principally two ways an argument can go wrong: either (1) the structure is wrong and doesn't support the conclusion or (2) one or more of the premises are false. Either or both of these problems might undermine an argument, and all it takes for the argument to run off the rails is for one step to fail. You can see why reasoning well can be so difficult.

To complete the two-step process, the critical thinker will first identify the premises and conclusion. Upon having identified premises and conclusion, the critical thinker will need to determine the support structure of the argument, which is to say, he or she will need to determine whether the argument is best understood to be deductive or inductive. It's the job of the next two chapters to explain some of the principal techniques logicians have developed for deciding whether an argument's structure supports or doesn't support its conclusion.

Be cautious when intellectually dancing our critical two step because the criteria for assessing whether a conclusion has been supported adequately differ between deductive and inductive arguments, and so evaluating inductive arguments by deductive criteria, or vice versa, will result in a misleading assessment of the argument. This is because the premises in a deductive argument are to support the truth of the conclusion completely, whereas inductive arguments have premises that only support the truth of the conclusion to some degree of probability.

For a deductive argument, anything less than a conclusion supported 100% by the premises is failure. Those deductive arguments that meet this criterion during Step #1 are, again, praised as *valid* deductive arguments, and those that fail to meet this criterion are condemned as *invalid* deductive arguments.

Of course, all inductive arguments will fail to meet the criterion of deductive validity, but that's not a problem for them. Inductive arguments, again, aren't to be evaluated by the same criteria as those used for deductive arguments, which is why it would be trivial and perhaps misleading to say that all inductive arguments are invalid. If the inductive argument provides enough support for the truth of the conclusion, such that it is sufficiently probably true, then it is called a *strong* inductive argument. If the inductive argument fails to do this, then it is a *weak* inductive argument.

Many of the sections in the remainder of this book are devoted to showing how critical thinkers can assess various sorts of argument, rhetoric, and claims, though it will require more advanced texts in logic, statistics, mathematics, rhetoric, critical theory, epistemology, and natural science to parse out many of those determinations thoroughly. Suffice it to say for now that once the critical thinker determines that the conclusion is well supported, then he or she proceeds to Step #2 to complete the argument's evaluation – and then perhaps to other forms of criticism we set out. If, however, the argument turns out to be invalid or weak, there may well be no need to proceed to Step #2, since the critical thinker will already know that in a logical sense the premises fail to support the truth of the conclusion. This is one reason logic is so basic to criticism.

Of course, just because an argument has passed Step #1 doesn't mean that its conclusion is true. All you know at that point is that *if* the premises are true, then the conclusion will be true or will likely be true – *and that's a very, very big "if."*

Now, determining whether or not the premises actually are true is the same as figuring out the truth of any other claim, really. Sometimes it's easy, and sometimes it's very difficult. One might say it's commonly a scientific or otherwise a factual issue, rather than a strictly logical question. If in any case a deductive argument is found to be both (1) valid and (2) to enlist all true premises, the conclusion *must* be true as well. When both these conditions are met, and only when both these conditions are met, you've reached the logical gold standard, and the deductive argument can be lauded with the highest praise logic can give by calling it *sound*. More formally:

Deductively valid arguments containing all true premises are called sound *arguments.*

Correlatively:

Inductively strong arguments having all true premises are called cogent *arguments.*

There is, however, an important caveat to cogency that is unlike its deductive counterpart, soundness. Because the truth of the conclusion for all inductive arguments

extends beyond the scope of evidence presented in the premises, for an inductive argument to be fully cogent, it cannot be the case that the argument fails to account for or ignores important evidence that would weaken the argument. This is called the *total evidence requirement*, and it is only required for cogent arguments. Not meeting the total evidence requirement risks committing what we'll see is called the fallacy of *suppressed evidence* (see 8.10).

SEE ALSO

2.6 Showing Invalidity by Counterexample
Chapter 3: Tools for Deductive Reasoning with Categories
Chapter 4: Tools for Deductive Reasoning with Claims
Chapter 8: Tools for Critical Thinking about Justification

READING

David Kelley, *The Art of Reasoning*, 3rd edn (2013)
Irving M. Copi, Carl Cohen, & Kenneth McMahon, *Introduction to Logic*, 14th edn (2010)

2.6 Showing Invalidity by Counterexample

One method it will be helpful to master for evaluating deductive arguments is exposing invalid forms by constructing what's called *counterexamples*. This method proves that an argument is flawed by showing that the argument's structure will not guarantee a true conclusion when its premises are true. When successful the test shows that a given argument's structure allows the *possibility* of having true premises but a false conclusion, which in every valid argument must be impossible. For an argument to be valid, it must be logically impossible for all of that argument's premises to be true while the conclusion is false, even if as things stand in the world that's not the case. One of the powerful dimensions of this method is, moreover, that it not only shows a particular argument to be bad, but it also proves that all arguments of the same form are also bad. This can be a very powerful tool for the critical thinker, because it allows for weeding out entire groups of bad arguments that share the same form. Any conclusions depending on these deficient argument forms have not been sufficiently supported.

The first step to showing invalidity by counterexample is *analyzing* the argument to determine its *form*. Suppose you conclude from "all sharks are animals with gills, and all sharks are fish," that "all fish are animals with gills." Is your argument valid? The

argument has two premises supporting the conclusion, which can be illustrated more formally as follows:

All sharks are animals with gills.
All sharks are fish.
All fish are animals with gills.

As it turns out, this argument has true premises and a true conclusion. That this happens to be the case, however, does not make it a good argument. It's just lucky. A sound deductive argument must not only have (a) true premises, but also (b) a conclusion that is logically supported by the premises. In this case, it turns out simply to be coincidence, an accident, that all the claims contained in it are true, which is not the case in a valid argument. Here's how to show that.

After deriving the basic structure of the argument, in terms of its premises and conclusion, the next step is to remove what we called in 1.1 the material content from the claims, leaving only the form of the argument. Once that's completed, this particular argument can be rendered in the following form:

All M are P.
All M are S.
All S are P.

For any deductive argument, deriving the argument's form is a process of reducing the argument to its most basic structures by substituting variables for particular content. Doing this is rather like replacing numbers with variables in mathematics to expose the basic mathematical formula of the original math problem. The variables serve as placeholders, and they can be any letter. In this case, "M" is used to take the place of "sharks," "P" takes the place of "animals with gills," and "S" stands in for "fish." (The reason we chose just these letters will be explained in Chapter 3.)

The Next Step (the tough part). After the form of the argument is determined, demonstrating that the form is invalid proceeds by substituting new content for the variables – M, P, and S – but not just any new content. The real skill in using this method is to select just the right substitutions so that the new argument has *true premises* but a *false conclusion*. In this example, if we substitute "dolphins" for M, "animals that live in water" for P, and "mammals" for S, the new argument becomes:

All dolphins are animals that live in water.
All dolphins are mammals.
All mammals are animals that live in water.

This new argument has the same form as the original argument, but as a result of substituting three new terms for M, P, and S, the argument now contains true premises

and a false conclusion. That's trouble. Big trouble, in fact, since true premises in a valid deductive argument must by definition invariably lead to a true conclusion. This argument, therefore, simply cannot be valid. This technique takes some imagination and some practice, but refining your skills in this area will bring rewards. The counterexample method of proving invalidity is a very powerful one and well worth your time to master.

Exercises and study questions

1. Determine the antecedent, consequent, necessary condition, and sufficient condition for the following claims:
   - If TyQuana scores a 95% on her final, then she will pass the course.
   - Foods are nutritious if they positively contribute to the overall diet of a person.
   - Water-saving measures are effective means for communities to deal with severe drought only if enough people participate in those measures.
2. Determine whether the following claims are contingent, self-contradictory, or tautologous:
   - Abraham Lincoln was the fifth president of the United States of America.
   - The M1A2 Abrams tank has a top speed of 45 miles per hour, even though it weighs approximately 62 metric tons.
   - Either I have a mouse in my pocket or I don't.
   - Thomas is a bachelor, but he is married to his spouse.
   - If the pie recipe requires 7 apples, then the pie recipe will be followed correctly only if the pie recipe requires 7 apples.
   - I exist!
3. Construct a counterexample to demonstrate that the following arguments are invalid:
   - All dogs are canines.
     No cats are dogs.

     No cats are canines.
   - If Tom is dead, then he was executed.
     Tom was executed.

     Tom is dead.
   - Some tools for computation are not solar powered.
     All calculators are tools for computation.

     Some calculators are not solar powered.
4. Determine whether the following argument is inductive or deductive, then explain why the argument is valid, invalid, strong, or weak.
   - The combined average verbal and math SAT score for incoming freshmen in 2005 was 900. The combined average verbal and math SAT score for incoming freshmen in 2009 was 890. This proves that the combined average SAT score for 2005 was higher than it was in 2009.

- Tony was a male freshman in 2005. In 2005, 40% of incoming freshmen males scored below the average combined SAT score. It's likely that Tony scored below the average combined SAT score.

SEE ALSO

3.4 Formal Deduction with Categories: Immediate Inferences
3.5 Formal Deduction with Categories: Syllogisms
Chapter 4: Tools for Deductive Reasoning with Claims

READING

David R. Morrow & Anthony Weston, *A Workbook for Arguments* (2011)
Anthony Weston, *A Rulebook for Arguments* (2009)
Karen Lambert & Bas van Fraassen, *Derivation and Counterexample* (1972)

NOTE

1. Students learn this series with the mnemonic sentence: Kings Play Chess on Fine Green Silk.

3 Tools for Deductive Reasoning with Categories

3.1 Thinking Categorically

Logic as the formal study of reasoning has been around for thousands of years. Aristotle (384–322 BCE) is commonly credited with having founded the discipline, although less systematic inquiries into reasoning certainly preceded him. Aristotle's principal approach to reasoning was through categories. *Categories* are useful tools for classifying and grouping things based on a shared property or properties. Grouping categorically allows the critical thinker to organize thoughts and concepts in ways that help to define and to delineate relationships clearly among categories as well as among members of categories. For example, to say that my car is blue is to say that my car belongs to a category of things that are blue. In fact, simply saying "my car" assumes a category of things that belong to me, as well as a category of things that are called "cars." The construction of categories is a basic building block of communication, as it would be exceedingly difficult to write or speak about the world without the help of category terms. For the purposes of critical thinking, moreover, possessing clearly defined and related categories is an important component of determining whether claims are true or false.

Types and tokens

To better understand categories, it's helpful to understand the *type–token distinction*. Roughly speaking, *tokens* are particular instances of things in the world, while *types* are general, abstract categories of things. The first US president, George Washington, is a token. He is a particular instance of something in the world. As such, George Washington belongs to many types, like man, human, US president, etc. These categories help critical thinkers distinguish the first US president, George Washington,

The Critical Thinking Toolkit, First Edition. Galen A. Foresman, Peter S. Fosl, and Jamie C. Watson.

from other people who happen to share his name but do not belong to all of the same categories.

Any token can be a member of many categories, and every category to which something belongs tells critical thinkers more about the thing in question. The science and practice of categorizing and classifying things is called *taxonomy*. Taxonomists understand the underlying theory behind the construction of categories, which allows them to put things in their appropriate category. For example, a biologist who has discovered a new organism must understand biological taxonomies to identify properly the new organism's place among similar organisms.

While the real-world consequences of identifying the types to which a token belongs are important for reasoning categorically, these issues typically become important during Step #2 of our Two-Step evaluation process (see 2.5), determining whether the premises are true. Furthermore, you should be aware that a lot of categorical reasoning occurs independently of tokens. For example, to say that all tigers are mammals is to make a categorical claim relating two types (or categories) of things, which does not rely on token examples to be true.

3.2 Categorical Logic

Categorical logic is a type of deductive reasoning that uses categorical claims. This type of deductive reasoning allows critical thinkers to construct valid deductive arguments from claims that relate categories to one another. Categorical logic seems to have been first formalized in a text by Aristotle that's come to be known as *Prior Analytics*. Here are some examples of categorical claims you might encounter in ordinary life.

Every politician takes pride in his or her work.
The mail is always on time.
Boats float on water.
If a Ford automobile is built in the US, then the workers who built it are unionized.
Only French citizens who are 18 years or older are permitted to vote in French elections.
There is a computer in the office.
Nowhere on Earth is free from climate change.

Quantity, quality, and standard form

Colloquially, categorical claims come in lots of forms, and it is often no easy task for critical thinkers to translate their ordinary way of talking about the relation of categories to a standard form that makes those relations clear. Logicians spent centuries developing a powerful system of categorical logic, but to use that system one has to translate ordinary statements into one of four *standard form* categorical sentences,

each named after the Latin term associated with their logical meaning. (For more on translating English claims to standard form, see 3.3.) Here's what their general forms look like:

A (from the first vowel in *affirmo*, affirmative):	All S are P.
E (from the first vowel in *nego*, negative):	No S are P.
I (from the second vowel in *affirmo*):	Some S are P.
O (from the second vowel in *nego*):	Some S are not P.

The basic parts: Each of the four standard form categorical claims is composed of a *quantifier*, a *subject term*, a *copula*, and a *predicate term*. In standard form, the *quantifier* is the first word of the categorical claim, and there are only three of them: "All," "No," and "Some." The *quantifier* is immediately followed by the *subject term*, S, which is the category or class being related to the *predicate term*, P, and the category or class that it designates. Linking S and P together is the *copula*, which is denoted by either "are" or "are not."

Quantity

For the critical thinker, categorical claims describe the extent to which the subject term is a member of the predicate term's category, and so the relationship described by these claims is entirely about class membership. (There's clearly, therefore, a lot of overlap here with set theory in mathematics.) The *quantifier* tells the critical thinker the categorical claim's *quantity*, which is the extent or scope of the subject term's category that is being related to the predicate term.

Categorical claims of type A and E are said to be *universal* in their quantity because they relate every member of the subject term's category to the predicate term. Categorical claims I and O, on the other hand, only assert a relationship between at least one member of the subject term's category to the predicate term, and so their quantity is described as *particular*. Note that the quantifier "Some," which is used to indicate the particular, has a very specific meaning for categorical claims. "Some" means "at least one," and allows for the possibility of more. In fact, *some* in this logical sense is consistent with *all* (since if something is true of *all* members of a set, it's certainly true of *some* of them). In common English, however, "some" often means something like "several," in the sense of more than one; and it often suggests *not all*. So it's important for the critical thinker when using categorical claims to keep the technical definition of "at least one and possibly more" in mind and never to assume that the term implies either that there are necessarily more than one or that the claim does not refer to all members of the relevant category.

Categorical claims either relate the entire category denoted by the subject term to the predicate term (logicians call this fully *distributing* the term), or they make the more limited claim of relating at least one member of the subject term's category to the predicate term (i.e., not fully distributing the term).

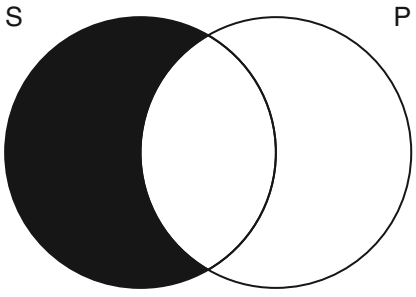
Quality

Now, having come to terms with quantity, there's a second property of standard form categorical sentences to discern: *quality*. Categorical claims are either *affirmative* or *negative*, depending on whether or not they are asserting class membership or denying class membership, respectively. The A- and I-claims are, as their name (deriving from ***Aff****I****r****mo***) suggests, affirmative, while the E- and O-claims are negative (from *n****Eg****O***). Because each type of categorical claim has one of the two properties of quantity and one of each of the two properties of quality, there are only 4 types of categorical claim. The table below shows how quantity and quality apply to each of the four categorical claims.

		Quality	
		Affirmative	*Negative*
Quantity	*Universal*	A-claims	E-claims
	Particular	I-claims	O-claims

Venn diagrams and the meaning of categorical claims

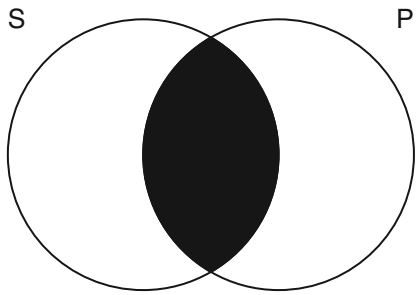
For the critical thinker, using standard form for categorical claims ensures that the meaning of any particular claim is clear. This clarity of meaning allows the critical thinker to make valid deductive inferences from one categorical claim to another (see 3.4), as well as construct valid deductive arguments called categorical *syllogisms* (see 4.5). The nineteenth-century logician John Venn (1834–1923) came up with a visual way of representing these relations. Some of this material can get pretty dry, and visual presentations can help a lot. Boole's technique is called, of course, the *Venn diagram*. The Venn diagrams below illustrate the categorical relationships spelled out by the four central pillars of the categorical system. Each category has its own circle. Here's an A-claim.



In this A-claim diagram, anything that's an S belongs in the S circle, and anything that's a P belongs in the P circle. The area where the S circle overlaps the P circle

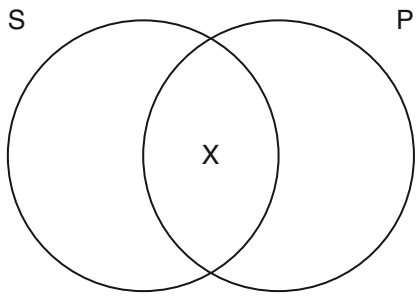
contains everything that is both an S and a P. Since the A-claim asserts that every member of class S also belongs to class P, the portion of the S circle that is outside the P circle has been shaded black to indicate that there are no members of S present outside of P. (Shading in is kind of like marking out or erasing.) The shaded area of a Venn diagram will always indicate that there is an absence or void of members, that the claim excludes them from those regions of meaning – hence, the black void.

Below is the Venn diagram for the E-claim; notice that the shaded region is only in the area where the S circle and P circle overlap, since the claim excludes anything from that region.



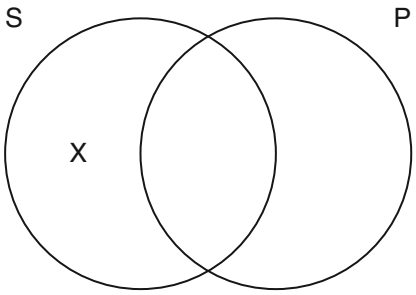
There can be no Ss that are also Ps, which means any members of S must be placed in the unshaded region of the S circle.

When a claim definitely asserts that members of a class (even one) exist in a particular region, the Venn diagram illustrates this with an "X" within that region. The I-claim, for example, asserts that Some S are P, which in terms of the quantity and quality means that at least one thing that is an S is also a P. Since that much is known for sure, the Venn diagram illustrates the information with an "X" placed in the area of overlap between the S and the P circles. Of course, so far as we know from the I-claim, it's possible that there are other Ss outside of P. It's possible too that there aren't. The claim doesn't say, so we just leave those areas blank and open.



Similarly, the Venn diagram for the O-claim illustrates that at least one member of S is not a member of P by placing an "X" in the S circle *outside* the area circumscribed

by the P circle. Again, this O-claim neither implies nor excludes there being Ss inside of P. That's why it's possible for I-claims and O-claims to be both simultaneously true or for just one of them to be true.



Distribution and its implications

Now, as we've seen, when a categorical statement makes a claim about every member of one of its categories it's said to *distribute* that category. Here we show the distributed categories in each of the four categorical claims. Unsurprisingly, the system covers all the possible combinations.

A: All S are P.	Distributes S only.
E: No S are P.	Distributes both S and P.
I: Some S are P.	Distributes neither S nor P.
O: Some S are not P.	Distributes P only.

For the critical thinker, distribution is useful because it helps us to understand better the implications of a categorical claim. Knowing that both S and P are distributed in an E-claim, for example, alerts the critical thinker to the fact that the E-claim asserts something about the entire category of S and the entire category of P. Again, the critical thinker knows that the entire category of S is outside the category of P, but it turns out that the E-claim also tells him or her that the entire category of P is outside the category of S. In other words, No S are P also means that No P are S. The same sort of symmetry, however, is not to be found with the A-claim.

No terms are distributed in the I-claim, because nothing about either the entire category of S or of P is implied by the fact that Some S are P. For the critical thinker, knowing that Some S are P implies nothing about *all* of S or *all* of P. That's not the case, however, for the O-claim. Some S are not P tells the critical thinker that there's at least one member of S that exists apart from the entire category of P, and so the critical thinker knows something about all of P, namely that it excludes some member of S.

One of the reasons it's useful to know about distribution is that there are five handy rules one can use to detect invalid categorical arguments. We'll address those rules in 3.5 once we get a bit more categorical logic under our belts.

Existential import

Another issue regarding categorical claims about which the critical thinker should be aware occurs with A- and E-claims and their relation to I- and O-claims. It's sometimes assumed that when an A- or E-claim is true there must actually be a member of S that exists. For example, the claim, "All monkeys are marsupials," (A-claim) may appear to imply that at least one monkey exists (a member of S) and that it must be a marsupial.

But philosophers and scientists found that things get sticky when dealing with hypothetical and otherwise imaginary entities. For example, a second Earth-sized planet added to our solar system or unicorns. Is it possible to say anything true about things that do not exist? In other words, do claims about imaginary things have existential import? Or when something does not yet exist but may someday, should we think that categorical claims about those sorts of things have existential import? The following two claims and their existential forms help to illustrate this issue and its solution.

I: Some unicorns are animals with only one horn.
O: Some interstellar spacecraft are not efficient means for picking up groceries.

At first glance, the I- and O-claims seem to assert something true, namely that unicorns are animals with only one horn and that interstellar spacecraft aren't efficient means for picking up groceries. Because I- and O-claims, however, carry existential import, these claims must be false. After all, unicorns and interstellar spacecraft (sadly) don't seem to exist. But for various reasons, one might wish to reason about them.

The problem is solved, however, by handling A- and E-claims differently – namely, by not assuming that they have positive existential import. That would make it possible for the I-claim and O-claim above to be false while nevertheless treating the statements as true in a way that makes no existential commitments. It then becomes possible to reason about such things – perhaps, for example, hypothetically or imaginatively:

A: All unicorns are animals with only one horn.
E: No interstellar spacecraft are efficient means for picking up groceries.

Alternatively, consider:

A: All Wookiees are furry creatures.
E: No Jedi are thoroughly evil beings.

Even though Wookiees and Jedi are both fictional, because A- and E-claims lack existential import, they can remain true even with their fictional subject terms. This approach to interpreting the existential import of universal claims is often credited to George Boole (1815–1864) and is called the "Boolean Standpoint" or "Modern Standpoint." Prior to the Modern Standpoint, logicians sometimes clunked along following Aristotle's interpretation of the universal categorical claims A and E. What's called the "Aristotelian Standpoint" or "Traditional Standpoint," accordingly, assumes that A- and E-claims *do* have existential import. If you like using the Aristotelian system, however, there is another option. Just stipulate the reality, or what's sometimes called the *universe of discourse*, about which you're reasoning and then stick with the Aristotelian system. For example, one might stipulate that one is reasoning about the fictitious universe of J. R. R. Tolkien's 1937 novel, *The Hobbit*, and then restrict existential import of your A- and E-claims to that reality.

3.3 Translating English Claims to Standard Form

Categorical logic offers powerful tools for making reasoning precise as well as for detecting faulty reasoning. But translating English claims into categorical propositions is not a perfect science. Ordinary language is riddled with complexity rarely noticed by those using it. Because of this, the rules for translation in this section are general but imperfect tools to help you with the translation process. They are a lot like measuring sticks, functioning perfectly well to assess the length of most objects, while leaving much to be desired when measuring the circumference of a ball. It is also important to point out that claims are made within particular contexts, and context can influence or even radically change the meaning of sentences. Translation, therefore, requires interpretation, and critical thinkers must be sensitive to the subtleties of language and expression as they go about the business of logical criticism.

A first rule for translating English claims into standard form categorical propositions is that the critical thinker *must have a clear understanding of the meaning of the original English claim*.

A second rule for translating ordinary claims to categorical propositions is that *the subject of the simple sentence determines the quantifier and subject term for the categorical proposition*, while *the predicate determines the predicate term* (though there are unfortunately exceptions).

Implicit quantifiers

Since the quantity of the translated subject term can only be universal or particular, you will need to determine whether or not the original claim refers to an entire class of things or at least one member from a class of things.

Example 1:	Snakes are cold-blooded animals.	All snakes are cold-blooded animals.
Example 2:	Snakes live under that shed.	Some snakes are things that live under that shed.
Example 3:	A few snakes are venomous animals.	Some snakes are venomous animals.

Note how similar Examples 1 and 2 are. It's only because of our mastery of ordinary contexts that we know which quantifier to use (no one who knows about snakes and sheds would think that *all* snakes live under one shed).

Individuals

When the subject refers to *a specific entity*, the quantity becomes *universal* and the subject term is worded to distinguish the individual from a whole category. This creates a class of things that has no more than that one member.

Example 3:	Thomas is a tall person.	All persons identical to Thomas are persons that are tall.
Example 4:	Springfield is the greatest city on Earth.	All places identical to Springfield are places that are identical to the greatest city on Earth.
Example 5:	My snake is a venomous animal.	All things identical to my snake are things that are venomous animals.
Example 6:	Tom's car accident is the worst accident I've seen.	All states of affairs identical to Tom's car accident are states of affairs that are identical to the worst accident I've seen.
Example 7:	Friday is the day after tomorrow.	All times identical to this Friday are times that are the day after tomorrow.

Getting the verb right

Our examples so far have conveniently used forms of the verb "to be," which requires almost no translation. But, of course, many claims in ordinary language don't use the verb "to be," as in "Many birds fly," "The bird smells gross," and "Many carnivorous

birds eat worms." So, the next important skill in translating English claims is replacing verbs with the copula "are," and later, "are not."

Many birds fly.	Some birds are things that fly.
The bird smells gross.	All birds identical with that bird are things that smell gross.
Many carnivorous birds eat worms.	Some carnivorous birds are things that eat worms.

All of the examples up to this point have dealt with the affirmative A and I categorical propositions. Let's take a look now at a few E- and O-claims.

Birds do not have gills.	No birds are things that have gills.
Teetotalers never drink beer.	No teetotalers are persons that ever drink beer.
Most of the class won't pass the test.	Some persons in the class are not persons that will pass the test.
None of the baskets have apples.	No baskets are things that have apples.
Nothing can replace his loss.	No things are things that can replace his loss.
Nowhere in the vacuum of space can you find a comfy recliner.	No places in the vacuum of space are places where you can find a comfy recliner.
Chris never drinks alcohol.	No persons identical to Chris are persons that drink alcohol.
I don't disagree with you.	No persons identical to me are persons that disagree with you.

Adverbials

While the critical thinker is familiarizing himself or herself with translating simple ordinary sentences into categorical form, a few special cases may cross his or her path. These special cases occur with adverbial clauses. Here are some examples of claims with adverbial clauses and proper translations for them:

Buy some bread when you get to the store.	All times you go to the store are times you buy some bread.
Whenever kids disappoint their parents they feel guilty.	All times kids disappoint their parents are times they feel guilty.

The keys are where I left them.	All places I left the keys are places the keys are.
Wherever you go there you are.	All places you go are places you are.
My fantasy football team will dominate if my running backs stay healthy.	All times my running backs stay healthy are times my fantasy football team will dominate.
If the Islamic State continues to grow, then the United States will commit ground troops to Iraq.	All times the Islamic State continues to grow are times the United States will commit ground troops to Iraq.

English claims with adverbial clauses that deny class membership can be tricky. Here are some examples of how you might translate them (depending, of course, on the context):

Don't buy bread when you get to the store.	All times you get to the store are times you don't buy bread. *Or* No times you get to the store are times you buy bread.
Whenever kids don't disappoint their parents, they feel acceptable.	All times kids don't disappoint their parents are times they feel acceptable.
The keys aren't where I left them.	All places I left the keys are places the keys aren't. *Or* No places I left the keys are places the keys are.
Wherever you fail to go there you are not.	All places you fail to go are places you are not. *Or* No places you fail to go are places you are.
My fantasy football team won't dominate if my running backs are injured.	All times my running backs are injured are times my fantasy football team won't dominate. *Or* No times my running backs are injured are times my fantasy football team will dominate.

If the Islamic State continues to grow, then the United States won't commit ground troops to Iraq.	All times the Islamic State continues to grow are times the United States won't commit ground troops to Iraq. *Or* No times the Islamic State continues to grow are times the United States will commit ground troops to Iraq.

Trust your instincts

Ultimately, ordinary language is full of unusual sentence structures for expressing claims that won't fit neatly into the patterns set out here. After all, the language has had centuries to evolve and adopt expressions that native speakers understand intuitively, even if they can't identify the subject and predicate of a sentence. The intuitive understanding we develop as masters of a language goes a long way toward constructing an accurate translation, because translation, at its core, is about retaining as much of the meaning of the original claim as possible in the newly translated categorical proposition. If you're a fluent speaker of a language with lots of background experience of how that language uses words, then trust your instincts with translation.

A caveat

Keep in mind, too, that translation into standard logical form doesn't create superior language *per se*. Words have many, perhaps countless, uses, and reasoning is just one of them. A gain in terms of logical clarification may be a loss in terms of poetic or persuasive force or subtle connotation. The tools of categorical logic are powerful, but they should not be thought to be revealing the essential or even necessarily the most important functions of language. Logic's great, but it's not all there is to critical thinking (see Chapter 10).

3.4 Formal Deduction with Categories: Immediate Inferences

If constructing an argument is like building a bridge, then an *immediate inference* is like a bridge with only one support. Under the right conditions, a single support can make for a perfectly good bridge, and similarly, a single premise may be all that is needed to support a conclusion. An *immediate inference* is an argument that proceeds from a single premise immediately to a conclusion. What immediate inferences lack in complexity they make up for in simplicity and elegance.