

# I. REASONING AND CRITICAL THINKING

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## 1.1 REASONING

The ability to reason is the fundamental characteristic of human beings. It has long been held that the capacity to reason is unique to human beings, but even if it is not—if it turns out, for example, that reasoning is a quality we share with dolphins or apes or even computers—the capacity to reason is nevertheless central to what we are and how we think of ourselves. Virtually every conscious human activity involves reasoning; we reason whenever we solve problems, make decisions, assess character, explain events, write poems, balance checkbooks, predict elections, make discoveries, interpret works of art, or repair carburetors. We reason about everything from the meaning of life to what to have for dinner.

Of course, much of the time we are not engaged in conscious reasoning; often we simply listen to what others say, take note of things around us, experience feelings, day-dream, listen to concerts, tell stories, or watch television. These activities need not involve conscious reasoning, but to the extent that we understand what is going on around or inside us we are not entirely passive. Some reasoning must be taking place, even if it is at a pre-conscious level. To understand reasoning properly, however, we need to understand how it differs from mere thinking. When we are merely thinking, our thoughts simply come to us, one after another; when we reason, we actively link thoughts together in such a way that we believe one thought provides support for another thought. This active process of reasoning is termed inference. **INFERENCE** involves a special relationship between different thoughts: when we infer B from A, we move from A to B because we believe that A *supports* or *justifies* or *makes it reasonable to believe in* the truth of B.

The difference between mere thinking and reasoning or inference is easy to understand through examples. Consider the following pairs of sentences:

*Alan is broke, and he is unhappy.*

*Alan is broke; therefore he is unhappy.*

*Anne was in a car accident last week, and she deserves an extension on her essay.*

*Anne was in a car accident last week, so she deserves an extension on her essay.*

*This triangle has equal sides and equal angles.*

*This triangle has equal sides; hence it has equal angles.*

Notice that the first sentence in each pair simply asserts two thoughts but says nothing about any relationship between them, while the second sentence asserts a relationship between two thoughts. This relationship is signaled by the words *therefore*, *so*, and *hence*. These are called **INFERENCE INDICATORS**: words that indicate that one thought is intended to support (i.e., to justify, provide a reason for, provide evidence for, or entail) another thought. Other common inference indicators include the following:

*since*

*thus*

*implies*

*consequently*

*because*

*it follows that*

*given that*

It is important to note that sometimes the inference indicator is missing; this can occur when a speaker thinks the inference is quite obvious. For example:

*It's raining; I'd better take my umbrella.*

The actual presence of an inference indicator is not important. What is important is the relationship of support between the thoughts of the speaker. This relationship is a defining condition of an inference: if two thoughts are linked by such a relationship, they constitute an inference; otherwise they do not.

When we express an inference in words, we do so by means of statements. A **STATEMENT** is a sentence (i.e., a set of words) that is used to make a claim that is capable of being true or false. If a sentence is not capable of being true or false, then it is not a statement. Questions (*Are you awake?*) and commands (*Wake up!*) are not capable of being true or false and, hence, are not statements. Only statements can be true or false. When an inference is expressed in statements, it is called an argument. An **ARGUMENT** is a set of statements that claims that one or more of those statements, called the **PREMISES**, support another of them, called the **CONCLUSION**. Thus, every argument claims that its premises support its conclusion.

## 1.2 THE CONCEPT OF LOGICAL STRENGTH

Since a statement makes a claim that can be true or false, any statement can be assessed by asking whether it is true or false. Is Alan really unhappy? Was Anne actually in a car accident? We can assess the truth or falsity of a statement in isolation, independent of its part in an argument (or a story or list, etc.). Every statement that is assessed without regard for its part in an argument must meet the same standard: truth. The truth or falsity of the statement *Alan is unhappy* does not depend upon whether it is part of an argument. To discover the truth or falsity of statements, we examine the statement itself and look for direct evidence that will show us whether it is true or false. Often, however, without further evidence it may be difficult or impossible to determine conclusively whether an isolated statement is true or false. This is why we construct arguments: they help us assess statements when the truth or falsity of a statement is not directly evident. It is also why we must learn to assess whole lines of reasoning in addition to assessing statements.

Assessing an argument is more complex than assessing an isolated statement. Since an argument always includes a claim that its premises support its conclusion, assessing an argument means assessing this claim. Do the premises really support the conclusion, and if so, how much support do they provide? In other words, how *strong* is the inference from the premise(s) to the conclusion? We say that an argument has **LOGICAL STRENGTH** when its premises, if true, actually provide support for its conclusion.

The concept of logical strength is central in critical thinking and has two important features that need to be stressed. First, the logical strength of an argument is independent of the truth or falsity of its premises: we do not need to know that the premises of an argument are true in order to assess its logical strength. When we assess the logical strength of an argument, we are really asking, *If the premises are true, would we be justified in accepting the conclusion?* and we can answer this question without knowing whether or not the premises actually are true. Consider the following example:

*The population of Chatham is 27,000.*

*The population of Orillia is 26,000.*

*Therefore, Chatham has a larger population than Orillia.*

Even if we don't know the populations of Chatham and Orillia, we can still see that the inference in this argument is a strong one. If both premises are true, then obviously the conclusion would have to be true as well. The fact that either or both premises might be false does not affect the logical strength of the argument. For

similar reasons, an argument with premises and conclusion that are known to be true may be a very weak argument. For example:

*Washington is the only city in the District of Columbia.  
The District of Columbia is in the United States.  
Therefore, Washington is the capital of the United States.*

In this example, the premises and the conclusion are all true, but the facts that Washington is the only city in the District of Columbia and that the District of Columbia is in the United States provide no support for the statement that Washington is the capital of the United States. The inference is therefore a bad or weak one. Only if the information contained in the premises really provides a good reason for holding that the conclusion is true can we say the inference is a strong one.

Second, the logical strength of an argument is often a matter of degree. Some arguments are so strong that the truth of the premises guarantees the truth of the conclusion. Such arguments are called **DEDUCTIVE ARGUMENTS**, and they constitute strict proofs. But most arguments are not as strong as this; usually, the truth of the premises makes it reasonable to hold that the conclusion is also true, but it does not provide an absolute guarantee. Such arguments are called **INDUCTIVE ARGUMENTS**. For example:

*Arthur has been a moderate social drinker for twenty years.  
No one has ever known him to get drunk.  
Therefore, he won't get drunk at the party tonight.*

This is a strong argument, since if the premises are true it is reasonable to conclude that the conclusion will also be true. Nevertheless, Arthur might get drunk tonight. Given the truth of the premises this might astonish us, but it is not impossible.

Understanding the concept of logical strength is the key to developing critical thinking skills. The fact that the logical strength of an argument is independent of the truth of its premises means that in order to assess an argument we must do more than merely determine whether its premises are true. And the fact that logical strength may be a matter of degree means that we must be sensitive to the various features of arguments that affect their degree of strength. If we lack critical thinking skills, we can easily be fooled into thinking that an argument is strong when the premises actually provide little or no support for the conclusion. Consider the following inferences:

*The Democrats won a majority of seats in the last election.  
So they must have received more votes than any other party.*

*My sister always got better grades in school than I did.  
That proves that she's smarter than I am.*

*Eighty per cent of those who tried Painaway said they would take it the next time they had a headache.  
Therefore, Painaway is a better headache remedy.*

*The city council is unfair to city employees.  
Jones is a city councillor.  
Hence, Jones is unfair to city employees.*

*A majority of the union members voted in favor of the contract.  
Consequently, these people must be in favor of the 1-per-cent pay reduction in the contract.*

*Whenever there is high unemployment, interest rates increase.  
So high unemployment causes high interest rates.*

These are all weak arguments: the conclusions are not adequately supported by their premises. This does not mean that the conclusions are false or even likely to be false. It only means that the evidence presented in the premises, even if true, does not entitle us to draw the conclusion. The premises do not, in other words, adequately support the conclusion.

### 1.3 TRUTH, LOGICAL STRENGTH, AND SOUNDNESS

In section 1.2 we drew a distinction between assessing the truth or falsity of a student and assessing the logical strength of an inference. Although these are quite different tasks, both are important if we want to arrive at the truth. Remember that a strong argument is one whose premises, if true, support its conclusion. In other words, its premises, *if true*, provide a justification for believing the conclusion to be true. But a logically strong argument, as we saw, may have false premises. So if we want to know whether the conclusion of an argument is likely to be true, we need to know *both* that the argument is a strong one *and* that its premises are true. What we want, in other words, are logically strong arguments with true premises. An argument that has both logical strength and true premises is called a **SOUND ARGUMENT**.

It is very important to be aware of the differences among these three properties. *Truth* is a property of statements and never of inferences. *Logical strength* is a property of inferences and never of statements. Logical strength refers to the inferential

connection between the premises and conclusion of an argument. *Soundness* is a property of an argument as a whole. Always keep the question of strength separate from the question of truth when dealing with any argument. Never ask simply, *Is this a good argument?* Ask two questions instead:

- (1) *Is this a logically strong argument?* and
- (2) *Are its premises true?*

The order in which these questions are asked is not important. What is crucial is that they be asked separately. Only when both have been answered are we in a position to know whether an argument is sound—whether we have a good reason to accept its conclusion.

Sometimes, however, it is inappropriate to ask whether the premises are true. We may, for example, want to explore the consequences of an assumption whose truth or falsity we cannot determine. For example:

*No one knows for certain whether Martin Bormann died in 1945. If he did not, then he probably escaped through Switzerland and Italy to South America. That is what Adolf Eichmann and a number of other high-ranking Nazis did.*

There are even times when we want to develop an argument with premises that we know or assume to be false. Such arguments are called **COUNTERFACTUAL ARGUMENTS** because at least one premise is a counterfactual statement. For instance, we may want to explore the logical consequences of some historical event that never happened; in this case, we posit a counterfactual claim as a supposition for the sake of argument. For example:

*If Hitler had invaded Britain in 1940 he would have succeeded, because at that time the Germans had military superiority.*

Or we may want to explore the consequences of the occurrence of some hypothetical situation. For example:

*If the state sales tax were reduced to 5 per cent, there would not be a corresponding decrease in government revenues. This is because part of the decrease would be offset by an increase in sales as a result of the sales-tax reduction.*

We should also note a special kind of counterfactual argument called the **REDUCTIO**

**AD ABSURDUM.** In a reductio argument, a statement is proven to be true by assuming it to be false and then deriving a contradiction from that assumption. For example:

*It is preposterous to claim, as some people have, that Gorbachev engineered the August 1991 coup attempt by Communist hard-liners in order to strengthen his position and stop the secessionist movements in the republics. If he engineered the coup then we would have to conclude that he is an exceptionally stupid man, for not only did the coup weaken his personal position and strengthen the position of Yeltsin, his chief rival, but it unleashed a wave of secessionism that destroyed the Soviet Union. Gorbachev may not be the smartest man in the world, but no one could have become political leader of the Soviet Union and been that stupid.*

In all these kinds of cases we want our arguments to be strong, but we cannot even pretend that these arguments are sound, since we know or assume that at least one of the premises is false.

Counterfactual arguments, however, are the exception to the rule. In almost all cases our main concern is with sound arguments. If we start with true premises, and use only logically strong arguments, we are entitled to rely on the conclusions we reach. Sound arguments expand our knowledge and increase our understanding. This is why developing the ability to recognize sound arguments is so important.

## 1.4 CRITICAL THINKING SKILLS

The primary focus of critical thinking skills is on determining whether arguments are sound, i.e., whether they have true premises and logical strength. But determining the soundness of arguments is not a simple matter, for three reasons.

First, before we can assess an argument we must determine its precise meaning. It would be convenient if the meaning of arguments were always clear, but unfortunately this is often not so. An argument may be unclear because the meaning of one or more of its statements is unclear or because the nature of the connection that is being asserted between the premises and conclusion is unclear. This means we have to learn how to interpret statements and arguments in a way that makes their meaning as clear as possible. The skills needed for this task are **INTERPRETIVE SKILLS**. Chapters 2 to 4 are aimed at developing these skills.

Second, determining the truth or falsity of statements is often a difficult task. Even when we are sure we know precisely what a statement means, we may be unsure about its truth and may even be unsure how to go about determining whether it is true or false. As we shall see, there are several different types of statements, and each

type has its own method for determining truth and falsity. The skills needed for this task are **VERIFICATION SKILLS**. We shall deal with these skills in Chapter 6.

Third, assessing arguments is complex because there are several different types of inference, and each type requires a different kind of assessment. It is necessary to learn how to recognize these different types of inferences and to become familiar with these different methods of assessment. For this purpose **REASONING SKILLS** are needed. These skills are dealt with in Chapters 7 to 15.

These three types of skills—interpretive skills, verification skills, and reasoning skills—constitute what are usually referred to as **CRITICAL THINKING SKILLS**. Developing a mastery of them is important for several practical reasons.

First, we are inundated with information of all sorts, but this information is useless unless we know how to use it in our thinking to draw out its implications and consequences. Much of it is incomplete and one-sided in ways that are often not apparent, and if we are not on our guard, we may be misled.

Second, we are constantly presented with arguments designed to get us to accept some conclusion that we would otherwise not accept. Politicians, preachers, advertisers, editorial writers, and special-interest groups of all sorts spend a great deal of time, thought, and money attempting to persuade us to believe the things they want us to believe, and it is important to be on guard against arguments that fail to meet the appropriate logical criteria. This is partly a matter of our own self-interest. When others seek to make us believe things that are in *their* interests, it is possible, or even likely, that our interests are not being well served.

Third, mastering critical thinking skills is also a matter of intellectual self-respect. We all have the capacity to learn how to distinguish good arguments from bad ones and to work out for ourselves what we ought and ought not to believe, and it diminishes us as persons if we let others do our thinking for us. If we are not prepared to think for ourselves, and to make the effort to learn how to do this well, we will always be in danger of becoming slaves to the ideas and values of others due to our own ignorance.

And finally, critical thinking skills can make it easier for us to persuade others to change their beliefs. Many beliefs are based more on emotion than on reason, although those holding them usually believe they are based on reason. In fact, it is rare to find a person, even a complete bigot, who does not believe that his or her beliefs have a rational basis. Critical thinking skills can be effective in dislodging such beliefs and persuading others to change their views.

This last point raises a number of moral questions. Like any skill, critical thinking skills can be used for good or ill. In fact, there are many ways in which they can be abused: they can be used to make a bad argument look much stronger than it



really is and to make an opponent's position look much weaker than it really is; they can be used to make ourselves look wise and to make others look foolish; they can be used to avoid having to respond to legitimate criticisms and to persuade others to change their beliefs for inadequate reasons. Every day we find ourselves in situations in which we could use our critical thinking skills for such purposes, and sometimes we may be tempted to do so. Yielding to the temptation, however, is dishonest and hypocritical. It is analogous to a medical doctor using his or her medical training not to help people but to torture them more effectively.

There are other, more difficult, moral questions that can arise. How far should we go in revealing to our opponents the weaknesses we see in our arguments? Is it always right to attack the weaknesses in the views of others? How are we to be fair to those who disagree with us? How far should we go in our attempts not to distort others' views when discussing them? How forceful should we be in attempting to persuade others to agree with our views? As we shall see, there are no easy answers to such questions. They need to be approached with an equal regard for the truth and for the feelings of others and with a proper sense of our own fallibility.

## 1.5 CRITICAL THINKING AND THE SCIENCE OF LOGIC

Reasoning skills involve the application of principles of logic. **LOGIC** is the science that studies the relationships between premises and conclusions with a view to determining when and to what extent the premises actually support the conclusion. Logic was first recognized as a science in the fourth century BCE by Aristotle, who described what he believed were the basic principles of correct reasoning. These principles were elaborated and developed by a number of medieval logicians, but the basic nature of logic remained essentially Aristotelian until the late nineteenth century. About a hundred years ago, logic entered a period of radical change when mathematicians began using logic to solve certain problems regarding the foundations of mathematics. More recently, computer science and artificial intelligence have contributed to further developments in logic. As a result, logic has become a highly complex and sophisticated discipline of considerable theoretical importance. The power and sophistication of modern logic, however, have been purchased at the price of increasing abstractness. The principles of modern logic have been abstracted from ordinary language and are considered as purely formal principles, devoid of content.

Many of the critical thinking skills described in this book are drawn from logic. Our interest in them, however, is not in their theoretical foundations or theoretical significance but in their practical application. In particular, we are interested in the way in which the

principles of logic function when used in natural language—that is, the languages such as English, French, or Mandarin that have evolved organically and continue to evolve as people use them in everyday life, as opposed to artificial languages such as the symbolic logic covered in Chapter 9 in which all the elements have fixed rules for usage. When any logical principle is used in a real-life setting, we face a host of special problems that take us beyond the domain of formal logic. These problems of practical application will engage most of our attention here. The principles of formal logic have their own interest and intellectual challenge, but they lie beyond the scope of this book.

There is, however, one underlying commitment that we want to preserve from the science of logic. This is something that Aristotle, the medieval logicians who followed his lead, and modern logicians who work on mathematical logic all seem to agree upon: it is that logic, as a science, is a study of normative principles, it does not merely describe its subject. **NORMATIVE PRINCIPLES** function as standards for assessment or guides for action, whereas descriptions merely attempt to accurately represent something. Henry Gray's *Anatomy* is a great work of physiology because it *describes* its subject accurately and comprehensively. Logic, however, does not simply discover in such a descriptive manner how people happen to reason. It explores the *norms* of reasoning and discovers how people *ought to* reason. Patterns of reasoning that have been identified as inductively or deductively strong are reliable for anyone to use.

But once a pattern of reasoning is discovered to be faulty or fallacious, we ought to avoid this pattern as unreliable. This is why the critical thinking skills outlined in 1.4 are so useful. There are reliable and unreliable ways of drawing implications and consequences out of information. There are reliable and unreliable ways in which other people attempt to persuade us to accept their positions. Conversely, there are reliable and unreliable ways in which we may persuade others to accept our reasoning. Most importantly, by becoming more aware of the principles of good reasoning, we *earn* our own intellectual self-respect by thinking in ways that measure up to the normative standards of good reasoning.

## 1.6 SELF-TEST NO. 1

I. Which of the following passages are arguments? For those that are arguments, identify the premise(s) and the conclusion.

1. You should go home next weekend because you promised your parents you would.
2. You should go home next weekend and have a good time with your friends.

3. Peter took the first place in the mile run at the NCAA Division III championships last year and has been training hard ever since, so he should win the championship easily this year.
  4. I will be able to visit you next month after all. The doctor just told me that a second operation won't be necessary and that I'll be able to go home this Friday.
  5. His car skidded on the ice and hit a van in the middle of the intersection. The car was a write-off, and the van suffered \$3,000 in damage.
  6. It is obvious that no great leader ever suffered from low self-esteem.
  7. The company laid off 250 assembly line workers last week. I think they were justified because their sales had declined by 23 per cent in the past three months.
  8. Many people think that thunder is caused by lightning. This is a mistake.
  9. Most evenings I go for a walk after dinner. Usually, I walk to the park and back, which is about two miles, but last night I only went as far as the library.
  10. You're crazy if you think you can take a full course load while working 20 hours a week and pass your semester. You should remember what happened to Van and Patti when they tried to do that last year.
  11. My purse with several hundred dollars in cash, my watch, and my necklace have gone missing from my hotel room. The door was locked while I was out, and there's no sign of forced entry. It looks like someone on staff at this hotel is a thief.
  12. We drove to Pittsburgh to visit Sally in the morning, spent the afternoon in Latrobe with Onno and his family, and then stopped at Betty's for dinner in Greensburg. By the time we finally arrived in Philadelphia last night, we were happy about visiting friends but tired from all the driving.
- II. When you know enough to judge the truth or falsity of the premises, indicate which of the following arguments are sound.
1. Albany is in New York. New York is in the United States. Therefore, Albany is in the United States.
  2. Montreal is larger than Beaver Creek. Beaver Creek is larger than Vancouver. Therefore, Montreal is larger than Vancouver.
  3. Shaquille O'Neal is taller than Steve Nash. Steve Nash is taller than Tom Cruise. Therefore, Tom Cruise is shorter than Shaquille O'Neal.

4. No one under the age of 18 is legally an adult. Katherine is only 15 years old. Katherine is not legally an adult.
5. Baseball is the United States' de facto national sport. A country's official or de facto national sport is likely to be very popular in that country. Therefore, baseball is likely to be very popular in the United States.
6. Fez is north of Casablanca. Tangier is north of Fez. Therefore, Tangier is north of Casablanca.
7. A cat makes a good house pet. A tiger is a cat. Therefore, a tiger makes a good house pet.
8. No human being is immortal. Even the President is a human being. Therefore, the President is not immortal.
9. Everybody loves a winner. The New York Yankees have won more games than any other baseball team since its inception. Therefore, everybody loves the Yankees.
10. At this moment, I am reading a book. If I am reading a book, I must be awake. Therefore, I must be awake.
11. The HMS Pinafore is a faster vessel than the SS Minnow. The SS Minnow is faster than the Yellow Submarine. Therefore, the Yellow Submarine is the slowest of the three vessels.
12. Dogs make excellent companions. Cerberus is a dog. Therefore, Cerberus is an excellent companion.

## 1.7 QUESTIONS FOR DISCUSSION

In section 1.1, an argument was defined as a set of statements that *claims* that its premises support its conclusion. Sometimes it is not clear whether a speaker intends to make such a claim. In these cases we have to rely upon whatever clues the context provides to decide whether it is reasonable to interpret what the speaker has said as being an argument rather than something else. For each of the following sentences or passages, briefly describe a context that makes it reasonable to interpret it as either an argument or not an argument.

1. The expressway was closed for three hours this afternoon because of the train derailment on the overpass.

2. When George finished speaking, Frances sat quietly for several minutes, her brow furrowed in intense concentration. Suddenly, she leapt up and ran to her room, rummaged through her desk, found a sheet of paper, and scrawled a few words on it. She crammed it in an envelope, addressed and stamped the envelope, ran out of the house, and thrust it into the mailbox. “That’s done,” she said. “Now I am committed, and my life will never be the same again.”
3. The company laid off 250 assembly line workers last week because their sales had declined by 23 per cent in the past three months. The company seems to have had no choice.
4. Mike refuses to vote because he thinks all political parties are the same.
5. I went for a walk last evening, but when I got to London Road it started to rain, so I turned around and came home.
6. Hey, it’s seven o’clock; it’s time to go.
7. To get rid of hiccups, breathe into a paper bag for a few minutes.
8. By the end of the war in 1945, Churchill realized that, although Britain had won the war against the Axis powers, it was an economically devastated nation that would need massive foreign aid if it was to recover.
9. This is an important decision, obviously, and I don’t want to decide in haste. I suppose, all things considered, that the best thing to do would be to resign, but I would like to have until tomorrow to think about it.
10. It is a beautiful day out, and a walk in the park will make you feel better.