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Critical Thinking

Timothy A. Crews-Anderson

'Human beings reason well when they take the time to do so'

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Critical Thinking and Informal Logic

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A Note on the Author

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Introduction: Thinking Skilfully

Try for a moment to imagine a field of human endeavour that does not require reasoning. This is likely to be impossible as there is little that human beings do that does not involve our ability to think. Many philosophers over the years have postulated that if there is anything essential to the human being, it is the capacity for reason. Indeed, thought is so fundamental to the human experience that it is only rarely that one is without it. The operations of the mind come so naturally and so easily that one scarcely realizes that they are going on. It is perhaps for this reason that the notion of thinking *skilfully* may seem strange.

The goal of this book is to consider thought as an activity, as an act or series of acts that a person deliberately, intentionally and wilfully undertakes. In simpler terms, the present purpose is to think about thinking. Close attention will be paid to the process of thought with the aim of evaluating reasoning and cultivating good thinking skills. This project falls within the confines of **logic**, which *is the branch of philosophy that studies the reasoning process and seeks to understand the differences between good and bad reasoning*.

Human beings naturally reason well when they take the time to do so, and if their attention is properly directed, they are, in the vast majority of cases, capable of great insight. If there is one fundamental difference between a person who is an incisive critical thinker and one who is not, it is that the critical thinker takes the process of thinking seriously, consciously attends to that process and asks the right questions. The focus, therefore, will be on the concerns that one should keep in the forefront of the mind and on which questions should be asked. It is also worth noting that this book does not introduce much that the average person does not already do. Everyone has carried out all of the described reasoning activities countless times. What the book offers is a careful cataloguing of the various types of reasoning with a discussion of which of them are reliable and which are not. It is, in a sense, a guided tour of the human capacity for reasoning along with instructions for its use.

With most human activities the development of skills does not come without practice, and it is no different with thinking. It is probably unreasonable to expect them to come easily, but it is almost certain that time and effort will pay a hefty dividend.

Considering the length of this book, its scope is perhaps somewhat larger than it should be. The idea is to present the basics of critical thinking and informal logic and to point the way towards further study, so it is perhaps best to consider the book as a primer. It will provide a solid introduction to the fundamental concepts and considerations as well as links to other resources on the web and in print.

Chapter 1: The Basics

Before delving into definitions of the basic elements of critical thinking, a brief overview of the structure of these elements will perhaps be helpful. The discussion offered in this book will focus primarily on the *argument*, which itself consists of at least two *propositions*. All arguments are either *deductive* or *inductive*, and an understanding of this distinction is required for criticism. The success of deductive arguments is evaluated in terms of what philosophers call *validity* and *soundness*, while inductive arguments are rated along a spectrum from weak to strong. Many of these words are familiar to most, but it is likely that they are associated with a number of different possible meanings. To remove these potential ambiguities, precise definitions will be introduced. The importance of a thorough familiarity with these concepts cannot be overstated.

1.1 Propositions

The precise nature of propositions is a matter of some philosophical debate, but for present purposes, it will suffice to define a **proposition** as *a claim or assertion that affirms or denies that something is the case*. All propositions are either true or false, and no proposition can be both true and false. Furthermore, they are the only sort of thing that can properly be called true or false. Put simply, propositions are the sole bearers of truth and falsehood, and as will become clear shortly, this feature is of crucial importance for identifying them in ordinary language. Here are some examples of propositions.

> All triangles have three sides.
> Either George W. Bush won the U.S. election, or John Kerry won it.
> People ought not to lie.[1]

1 There is some debate among philosophers about the nature of "ought" claims. Some deny that such statements are propositions, claiming rather that they are either non-propositional commands or expressions of emotional attitudes. Click here for an overview of the work of A. J. Ayer, a proponent of this view.

If today is Wednesday, then tomorrow is Thursday.
All circles are squares.

The majority of propositions that one encounters come in the form of a declarative sentence, but it is important to note that a proposition is not identical to the sentence that expresses it. A proposition is that to which a declarative sentence refers. For this reason, multiple sentences may express or refer to the same proposition.

George W. Bush won the U.S. election.
The U.S. election was won by George W. Bush.
George W. Bush was the winner of the U.S. election.

It is perhaps helpful to think of a declarative sentence as pointing to a kind of abstract object. It is this sort of object that philosophers have termed a proposition.

Non-propositional language: exclamations, commands, and questions

There are many uses of language that do not express propositions. As noted above, all propositions are either true or false, so whether a particular phrase or sentence can be considered to be true or false will determine if it indeed expresses a proposition. Consider the following.

What are we doing here?

To decide whether this question expresses a proposition, simply ask whether it makes sense to say that, "what are we doing here?" is either true or false. Clearly it does not, and just as clearly this sentence does not express a proposition. Another tactic is to add, "It is the case that…" in front of the phrase in question and consider whether this new construction makes sense. If it does, then it is very likely that the phrase expresses a proposition. If it does not, then it is likely a non-propositional use of language. Consider.

It is the case that, "what are we doing here."

This is, of course, nonsensical. By contrast, consider the following propositions.

It is the case that, “all triangles have three sides.”
It is the case that, “either George W. Bush won the U.S. election, or John Kerry won it.”
It is the case that, “people ought not to lie.”
It is the case that, “if today is Wednesday, then tomorrow is Thursday.”

The concern here is not whether the constructed sentence is true or false but whether it makes sense. Consider a false proposition.

It is the case that, “all circles are squares.”

Obviously this claim is false, but it does make sense, and thus the phrase “all circles are squares” expresses a proposition.

Other non-propositional uses of language include commands and exclamations.

Go to bed.
Oh, no!

A quick consideration of each of these constructions reveals that they are neither true nor false and thus do not express propositions. Note that the following do not make sense.

It is the case that, “go to bed.”
It is the case that, “oh, no!”

This provides the basis for a general rule. *Questions, commands, and exclamations do not express propositions*. They are non-propositional uses of language.

Questions of interpretation: rhetorical questions as assertions and commands as normative claims

It should not come as a surprise that there are exceptions to this rule. In some cases certain questions or commands can be interpreted as actually expressing propositional language.

A **rhetorical question** *is a question that is meant to have an obvious answer and can be interpreted and reformulated as a declarative sentence that expresses a proposition*. Consider the meaning of the question “who won the 2007 election?” in the following.

> Marie: I think it is clear that France is moving to the right politically.
> Thomas: I'm not so sure.
> Marie: And who won the 2007 election?
> Thomas: It's a good point, but I am still not entirely convinced.

In this dialogue, Marie is not really wondering who won the French election in 2007. She is, rather, asking a question that is entirely rhetorical. The meaning of this phrase should be interpreted as "Nicolas Sarkozy won the 2007 French election," which is clearly a propositional use of language.

Like rhetorical questions, it is sometimes possible to interpret and reformulate a command as a proposition. Consider.

> Don't lie.

In some contexts, this command is simply a non-propositional command that is neither true nor false. In others, however, it can be interpreted as a normative claim that contains "ought" or "should." If this is the case, then it can be reformulated as one of the following declarative sentences, both of which express a proposition.

> You should not lie.
> You ought not to lie.

Unfortunately, the correct interpretation of language is seldom a straightforward task. It requires constant and careful thought about what the author or speaker actually means. Rhetorical questions and commands that express normative claims are fairly common, and when critically analyzing an argument, it is important to recognize them and to reformulate them as clear and concise declarative sentences.

Simple and compound propositions

A **simple proposition** *makes only one claim or assertion*, and a **compound proposition** *contains two or more simple propositions*. There are three distinct types of compound propositions, and it is important both to recognize them and to understand the conditions under which they are true or false (truth conditions).

Conjunctive propositions

The first type is a **conjunctive proposition**, which *consists of two or more simple propositions that are connected by the conjunctions "and" or "but."* While these two words carry somewhat different connotations, they have the same truth value, so for present purposes, they will be treated as synonyms. Here are some examples of conjunctive propositions.

> Nicolas Sarkozy won the French election, and Ségolène Royal lost.
> All triangles have three sides, and all circles are squares, but all squares have four sides.

A conjunctive proposition asserts each of its simple parts, so such propositions are true just in case all of the simple propositions that it contains are themselves true. If one or more of the constitutive simple propositions is false, then the entire conjunctive proposition is false. The first example above is true because both simple propositions are, in fact, true claims. With respect to the second, while it is the case that all triangles have three sides and that all squares have four, it is not the case that all circles are squares. Thus, the second example is false.

Disjunctive propositions

The second type of compound proposition is a **disjunctive proposition**. *Such propositions contain two or more propositions that are connected by "or."* There are actually two possible meanings of the word "or," and for reasons that will become clear later, it is important to carefully distinguish between the two. The "inclusive or" means "one or the other or both" while the "exclusive or" means "one or the other but not both." In this book, the inclusive meaning will be assumed, and any use of the exclusive will be noted. Following are some examples of disjunctive propositions.

> Either George W. Bush won the US election, or John Kerry won it.
> Either George W. Bush is the US President, or Nicolas Sarkozy is the French President.
> All circles are squares, or all triangles have three sides.

A disjunctive proposition is false if and only if all of the constitutive simple propositions are false. If one or more of them are true, then the entire disjunctive proposition is true. Consider now an implication of these truth conditions.

Assume that the following disjunctive proposition is true.

> All gadgets are widgets, or all widgets are sprockets.

Based merely on the knowledge that this proposition is true, is it possible to infer that either of the simple propositions is true? Indeed, while it can be said for sure that one of them is true, it is impossible to say for sure which one. There are several possibilities.

> "All gadgets are widgets" is true, and "all widgets are sprockets" is false.
> "All gadgets are widgets" is false, and "all widgets are sprockets" is true.
> "All gadgets are widgets" is true, and "all widgets are sprockets" is true.

This example illustrates the fact that unlike a conjunctive proposition, a disjunctive proposition does not, in fact, assert each of its constitutive propositions; rather, it asserts only that at least one of them is true without revealing which one.

Hypothetical propositions

The third and final type of proposition is the hypothetical. A **hypothetical proposition** *consists of two propositions connected by "if…then."*

> If you look into the abyss, then the abyss will change you.

A couple of terms are helpful for discussing hypothetical propositions. The **antecedent** *is the constitutive proposition that is governed by "if."* The **consequent** *is the constitutive proposition that is governed by "then."* A hypothetical proposition is false if and only if its antecedent is true and its consequent is false. Otherwise, it is true. These conditions can generate some strange results. Consider the following *true* propositions.

> If the sun revolves around the earth, then the sum of two and two is four.
> If the sun revolves around the earth, then the sum of two and two is five.
> If the earth revolves around the sun, then the sum of two and two is four.

In none of these examples is it the case that the antecedent is true and the consequent false, thus all of the examples are true. This is straightforward enough with respect to the third example as it is indeed the case that "the earth revolves

around the sun" and that "the sum of two and two is four," but it may seem somewhat strange to say that the first two examples are true. While counterintuitive, a hypothetical proposition with a false antecedent is always true (albeit trivially so) regardless of the truth or falsehood of its consequent.

One might wonder why this is so, and this is indeed a good question. It may help to keep in mind the precise assertion that hypothetical propositions actually make. Unlike conjunctive and disjunctive propositions, they do not make a claim about the truth of either or both of their constitutive propositions. They do, however, affirm a relationship of some sort between them. The precise nature of this relationship depends greatly on the context of the proposition, but in general terms, it can be said that a hypothetical proposition makes the claim that the truth of the antecedent is sufficient for the truth of the consequent.

With this in mind consider the structure of a false hypothetical proposition. Since the antecedent is true and consequent is false, the claim that the truth of the antecedent suffices for the truth of the consequent is demonstrated to be false. Moreover, since the claim being made about the consequent depends entirely on the antecedent being true, a false antecedent has no bearing whatsoever on the truth of the consequent. Thus, a false antecedent means a true hypothetical proposition regardless of the truth or falsehood of the consequent.

On a final note, considering the above examples, it may seem strange to think that the behaviour of the sun and earth is, in any way, sufficient for the truth of basic arithmetic. A likely source of this discomfort is the assumption that the relationship being claimed by these propositions is one of cause and effect. While this is certainly one possible meaning of the affirmed relationship, it is not the only one. For this reason it is not safe to assume the precise nature of the relationship without carefully considering the context in which the proposition occurs. The only universal way to show that any hypothetical proposition is false is to show that the antecedent is true while the consequent is false.

These are the three basic types of compound propositions. Things can, however, be quite a bit more complex. The constitutive propositions of a compound proposition can themselves be compound. This can make for propositions that are quite monstrous for lack of a better word. Here are some examples.

> Genghis Kahn was Mongolian, but if Julius Caesar was Roman, then Napoleon Bonaparte was German, and Alexander the Great was Greek.

> If there is a God, and He is all-powerful, all-loving, and all-knowing, then there should not be pain and suffering, and if there is pain and suffering, then God does not exist, or is not all-powerful, all-loving, and all-knowing.

Determining the truth values of complicated propositions requires specific rules of precedence similar to the order of operations in arithmetic. This procedure requires precise interpretation and symbolization, and for this reason, it will not be introduced here. For those who are interested, any of the introductory texts to symbolic logic mentioned in Appendix B will explicitly deal with this question.

Considering propositions

Only rarely can philosophy, logic or critical thinking skills help someone determine whether a proposition is actually true or false. The sorts of propositions that are commonly encountered in the course of daily life will most likely require evidence that cannot be supplied by a philosopher. That being said, it is crucial to thinking skilfully to consider carefully what it would take to prove that a given proposition is true. What burden must be met if a compelling case is to be made, and how might someone meet that burden? Consider a claim that one can easily imagine hearing on the evening news.

> Divorce rates in the United States have decreased substantially over the last three years.

Think for a moment about what kind of information would be necessary to support a claim like this. For this particular proposition, demographic studies and reliable statistics would be required. Other propositions will call for different kinds of support. Here are some more examples.

> All triangles have three sides.
> God exists.
> U.S. President Harry Truman used atomic weapons on Japanese cities in order to frighten the Soviets.

The first example requires nothing more than a proper understanding of the definition of a triangle, thus little more needs to be said to show that it is true. The second example, however, is far more problematic as it is very likely impossi-

ble to know for sure whether it is true. Indeed, there are many propositions for which this is the case. The third is also a difficult claim to prove. What kinds of evidence and information would be required to support it? Clearly, it would be extremely difficult to remove all doubt, but it might very well be possible to offer strong supporting evidence for or against it. Such evidence would likely include historical documents, eyewitness accounts of Truman's decision-making process, etc.

Coming to at least a cursory understanding of the burden of proof that a proponent of a claim must meet is absolutely fundamental to a good critical analysis. As the discussion moves from propositions to arguments, it will be very helpful to keep this in mind.

For the sake of concision, propositions will often be represented as capital letters throughout this text. P is the default designation for a proposition, Q is a proposition that is not P, R is a proposition that is neither P nor Q, and so on. To express the negation of a proposition, a "not" will simply be placed in front of the letter.

> If "P" is "the cat is on the mat," then "Not P" is simply "the cat is not on the mat" or "it is not the case that the cat is on the mat."

Keep in mind that the negation of a denial is a possibility.

> If P is "people ought not to lie," then "Not P" would be "it is not the case that people ought not to lie" or simply "people ought to lie."

Finally, the negation of a particular proposition always bears the opposite truth value of that proposition, so if "P" is true, then "Not P" is false and vice versa.

1.2 Arguments and Inferences

The English word "argument" has many meanings, and when most people hear it, they think of a (perhaps heated) disagreement. It is very likely that they do not immediately think of philosophy or critical thinking. Perhaps they should however, because the argument, or rather a particular kind of argument, is the philosopher's bread and butter. In philosophy, an **argument** *is a group of two or more propositions that express an inference.* An **inference**, in turn, *is a mental*

process of linking propositions by offering support to one proposition on the basis of one more other propositions. The **conclusion** of an argument *is that single proposition which is supported by other propositions*, and a **premise** is *a proposition that provides a basis of support for the conclusion*. Consider the following argument.

> P_1: If you look into the abyss, then the abyss will change you.
> P_2: The abyss did not change you.
> C: Therefore, you did not look in to the abyss.

In this example, P_1 and P_2 are premises, and C is the conclusion. All three propositions taken together are the argument. The inference, however, does not lie here on the screen. It is a mental activity, and as such, it occurs in the mind. Indeed, the inference is an instance of the reasoning activity for which human beings are so famous. Recognizing the differences between good inferences, those in which the premises provide adequate support for the conclusion, and bad ones, those in which the premises are inadequate to this task, is the essence of critical thinking and the primary focus of logic.

1.3 Deductive and Inductive Reasoning

A **deductive argument** *is one in which it is claimed that the premises provide a guarantee of the truth of the conclusion.* In a deductive argument, the premises are intended to provide support for the conclusion that is so certain that, if the premises are true, it would be impossible for the conclusion to be false. Because successful deductive arguments are those in which the conclusion is completely *guaranteed* by the premises, the conclusion must be contained within the premises. The conclusion cannot go beyond what the premises implicitly assert. For this reason, deductive arguments are usually found in inferences that follow from definitions, mathematics and rules of formal logic. The following are examples of deductive arguments.

> There are 32 books on the top-shelf of the bookcase, and 12 on the lower shelf of the bookcase. There are no books anywhere else in the bookcase. Therefore, there are 44 books in the bookcase.

> Melbourne is either in Victoria or New South Wales. If Melbourne is in Victoria, then

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