TRUTH, VALIDITY, SOUNDNESS;

DEDUCTION & INDUCTION

(Taken from Engel, *With Good Reason)*

EVALUATING ARGUMENTS: TRUTH, VALIDITY, AND SOUNDNESS

People are sometimes heard to say, "That may be logical, but it' not true," or, "What's logical isn't always right." Both of these views are correct, yet they do not mean that logic is unconcerned with *truth.* Indeed, logic defines truth rigorously and separates it from two other concepts-*validity* and *soundness*-with which it is sometimes confused in ordinary speech. Together, these three concepts provide a basis for evaluating any argument.

Aristotle, who founded the science of logic in the fourth century B.C., was the first to discover this distinction between truth and validity. It was, perhaps, his most important contribution to this subject.

Validity refers to the correctness with which a conclusion has been inferred from its premises-whether the conclusion *follows* from them: Truth, on the other hand, refers to whether those premises and conclusion accord with the facts. It is thus possible in logic to start with true premises but reach a false conclusion (because we reason badly with those premises) or to reason correctly or validly without reaching a true conclusion (because our premises are false). Soundness results when the premises of an argument are true and its conclusion validly derived from them. Otherwise the argument is *unsound.*

Truth and falsity, validity and invalidity, can appear in various combinations in argument, giving rise to these four possibilities:

1. We may have our facts right (our premises are true), and we may use them properly (our inference is valid). In such a case not only will our argument be valid but our conclusion true. The argument as a whole will be sound.

a) All men are mortal.
Socrates is a man.
Therefore Socrates is mortal.

2. We may have our facts right (our premises are true), but we may make improper use of them (reason invalidly from them). In this case our conclusion will not follow, and the argument as a whole will be unsound.

b) All cats are animals.
All pigs are animals.
Therefore all pigs are cats.

On some occasions the conclusion of such an argument may accidentally happen to be true, as in:

c) All cats are animals.
All tigers are animals.
Therefore all tigers are cats.

In such a case we cannot determine the truth of the conclusion from the argument itself; the conclusion may be true but not for the grounds offered in defense of it in this argument.

3. We may have our facts wrong (one or more of our premises is false), but we may make proper use of them (reason validly with them). In this case, our argument will be valid but unsound.

d) All movie stars live in Hollywood.
Robert Redford is a movie star.
Therefore Robert Redford lives in Hollywood.

Here the first statement is clearly false, yet the reasoning is valid and the conclusion follows from the premises. As in case 2 above, the conclusion may happen to be true but we cannot determine its truth within the terms of the argument. It might be true despite the falsity of the first premise; on the other hand, it might be false despite the validity of the reasoning. In order to reach a conclusion that we can depend

on to be true, it is not enough to reason validly; we must do so from true premises.

4. There is, finally, the case in which our facts are wrong (one or more of our premises is false) and we also make improper use of them (reason invalidly from them). In such a case the argument will be both invalid and unsound.

e) I like this course.
All final examinations are easy.
Therefore I will receive a high grade in this course.

Table 1.1 summarizes these relations.

Table 1.1 The Four Types of Argument

	Premises	Validity	Soundness
1	True	Valid	Sound
2	True	Invalid	Unsound
3	False	Valid	Unsound
4	False	Invalid	Unsound

- Truth and falsity are descriptive of the properties of statements alone.
- Validity and invalidity refer to reasoning and are determined independently of the truth or falsity of the premises or conclusion of the argument.
- If in addition to being valid an argument contains true premises, the argument must be considered sound. Otherwise, it must be considered unsound. All sound arguments, therefore, are valid, but valid arguments can be either sound or unsound.
- A conclusion reached by way of false and/or invalid reasoning may be accidentally true. This does not obligate us to accept the argument – it is still unsound.

Since only one of the argument types we have discussed can yield conclusions that must be true, the reader may wonder why we should be interested in arguments whose premises are false. For better or worse, we are sometimes in a position where we do not know whether our premises are true. Being able to infer validly the consequences which would flow from such premises if they were true enables us to judge whether they are true. For if, by a deductively valid inference, we should arrive at a conclusion that we know is false, then we can be sure that at least one of our premises is false, because a false conclusion cannot validly be deduced from true premises. An interesting example from the history of science concerns the formerly held corpuscular theory of light. This theory maintained that particles of flight must travel in straight lines through empty space, but it eventually was realized that if this theory were true, then light particles traveling through a circular hole in an opaque shield would project a sharply defined circle of light onto a screen behind the shield. In a subsequent experiment using a very tiny hole, however, the image projected on the screen was not a sharply defined circle of light at all, but rather consisted of concentric alternating light and dark rings. The experiment showed that light does not travel in straight lines but rather in wavelike undulations. The corpuscular theory came to be replaced with the wave theory of light.

Knowing, therefore, that something can follow from something else even though what it follows from is false can be enormously useful. For this means that if you are uncomfortable with a conclusion seemingly validly derived from a premise, it is possible you are not in full agreement with the premise from which it is, apparently, correctly deduced. The trouble may therefore lie in the premise.

EXERCISES:

Which of the following statements are true and which are false?

If the conclusions of our arguments have been derived validly from our premises, then we know that such conclusions are true. False

If the conclusion of our argument has been derived validly from our premises, then we know that this argument is sound. False

If our premises are true, and our conclusion has been validly derived from these premises, such an argument is called sound. True

All valid arguments are sound. False

All sound arguments are valid. True

A conclusion validly derived from premises may nevertheless be false. True

A conclusion invalidly derived from the premises may nevertheless be true. True

DEDUCTIVE AND INDUCTIVE ARGUMENTS

It remains for us to ask two important and crucial questions of an argument: Are the premises true? Does the conclusion really follow from them? Architect analogy

Regarding the first question, we want to know whether the facts stated by the argument are really so. Or do they perhaps misrepresent or falsify them? Do they prejudge them? Are they, perhaps, misleading as stated? Premises, after all, are the foundation of an argument; if they are unreliable or shaky, the argument built on them will be no better.

There is, however, another way an argument can go wrong: when the relationship between the premises and conclusion is such that the premises fail as a support of the conclusion in question.

A premise can support a conclusion either fully, partially, or not at all, as shown below:

Fully:
All men are mortal.
Socrates is a man.
Socrates is mortal.

Partially:
Most Scandinavians are blonde.
My cousin Christine is Scandinavian.
She is blond, too.

Or

Not at all:
"Be sure to brush with Colgate.
Walt Frazier wouldn't think of
brushing with anything else."

Let us consider the first two: the first is called *deductive*, the second *inductive*. Deductive arguments are arguments in which the conclusion is presented as following from the premises *with necessity*. Inductive arguments, on the other hand, are arguments in which the conclusion is presented as following from the premises only *with probability*.

Two examples will help illustrate this distinction between necessary and probable inference.

a) *Deductive*

All the beans in that bag are black.
All these beans are from that bag.
All these beans are therefore black.

Contained w/in premises

b) *Inductive*

All these beans are from that bag.
All these beans are black.
All the beans in that bag are therefore black.

beyond premises

Of these two arguments, only the first (argument *a)* has a conclusion that follows with certainty from its premises – since all the beans in the bag are black, I could not possibly have pulled out a different color. The conclusion of argument *b* follows only with some degree of probability from its premises – there *might* be some beans in the bag that aren't black, but I didn't happen to take them.

One difference between deductive and inductive arguments, it will be observed, is that the premises in a deductive argument contain all the information needed in order to reach a conclusion that follows with necessity. The conclusion refers to nothing outside the premises. In the conclusion of an inductive argument, on the other hand, we must venture beyond information contained in the premises. Thus our conclusion can never be certain, although it can have a high probability of being true.

It is because deductive arguments either prove or fail to prove their conclusions with certainty that we say of them that they are either valid or invalid; inductive arguments, on the other hand, are said to be either good or bad, strong or weak.

A classic example of inductive argument highlights this issue of certainty.

c) The sun has risen every morning since time immemorial.
Therefore the sun will rise tomorrow morning.

We feel sure that the sun will rise tomorrow, yet logically speaking the relation of this conclusion to its premises is one of probability, not necessity. (As the renowned logician Bertrand Russell once put in *The Problems of Philosophy,* "The man who has fed the chicken every day throughout its life at last wrings its neck in.") In inductive arguments, we assert in the conclusion a fact itself contained in the premises. In argument *c* above, for example, the premises make assertions only about the past; they assert nothing about what will happen in the future. Therefore the premises do not rule out the possibility of the conclusion being false, since they yield a conclusion whose truth is only probable with respect to these premises, not necessary. It is in the nature of inductive arguments to carry us beyond what is asserted in the premises so that we may see what implications those premises have for other events.

Deductive reasoning is precisely the reverse. Here we do not attempt to go beyond the premises but to understand more specifically what they reveal. In the following example, everything stated in the conclusion is strictly derived from information contained in the premises.

d) If there are 50,001 people in a town,
And if no person can have more than 50,000 hairs on his or her head,
And if no one is completely bald,
Then at least two people in the town have the same number of hairs on their heads.

This example illustrates the precision of which deduction is capable. Whereas inductive arguments expand the content of their premises at the sacrifice of necessity, deductive arguments achieve necessity by sacrificing expansion of content. Most of the arguments one encounters in daily affairs are of the inductive type.

- A deductive argument attempts to show that the conclusion must follow from the premises; an inductive argument that it is only likely to follow from the premises.
- The premises of a deductive argument must, therefore, offer all the data or information necessary to draw the conclusion in question. The premises of an inductive argument need contain only enough information to make the conclusion seem probable--the conclusion goes beyond what is absolutely given in the premises.
- Thus, inductive arguments may include a great deal of information, but to do so they give up proving their conclusions with certainty.
- Deductive arguments are either valid or invalid; inductive arguments are either strong or weak.