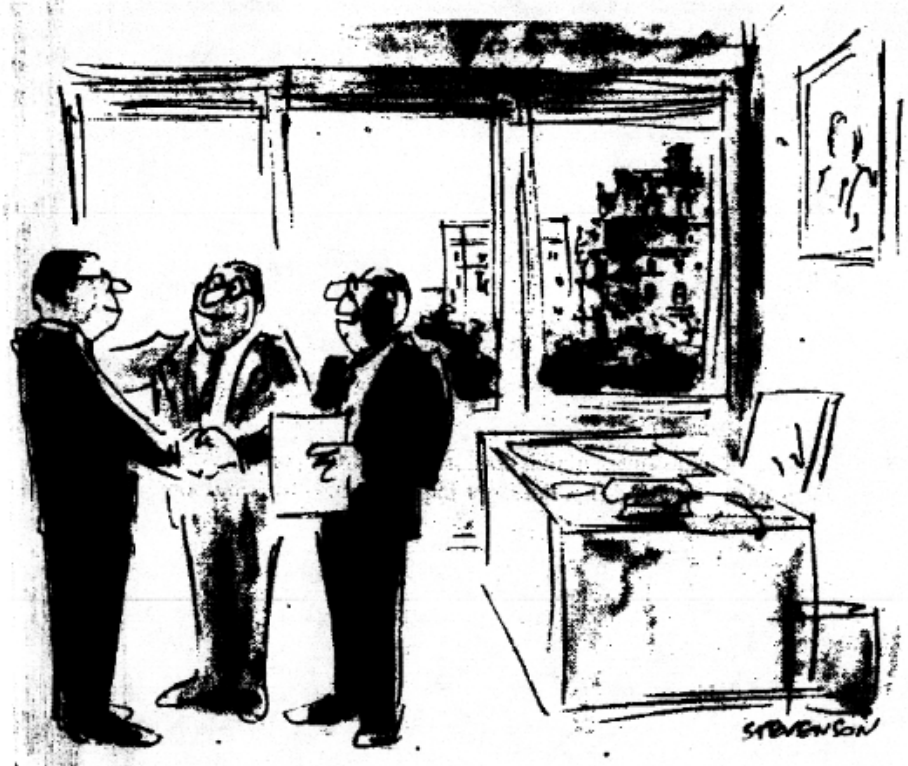

Drawing by Stevenson; © 1987 The New Yorker Magazine, Inc.

"Congratulations, Dave! I don't think I've read a more beautifully evasive and subtly misleading public statement in all my years in government."

Cartoon commentary on the state of contemporary rhetoric.

It's much easier to do and die than it is to reason why.

— H. A. Studdert Kennedy

Read not to contradict and confute, nor to believe and take for granted . . . but to weigh and consider.

— Francis Bacon

You can lead a man up to the university, but you can't make him think.

— Finley Peter Dunne

You can lead me to college . . . but you can't make me think.

— Sweatshirt update seen at Duke University

Chapter 1

Good and Bad Reasoning

There is much truth to the old saying that life is just one problem after another. That' why problem solving is one of life's major preoccupations. **Reasoning** is the essentia ingredient in problem solving. When confronted with a problem, those of us who ar rational reason from what we already know, or have good reason to believe, or can fin out, to new beliefs useful in solving that problem. The trick, of course, is to reason wel This book is about good reasoning—about how to reason well in everyday life—whethe dealing with personal problems or those of a social or political nature.

Fortunately, no one is an island. We all have available to us a great deal of knowledg others have gained through experience and good reasoning—accurate information an well-intended advice available to anyone who reaches out for it. Unfortunately, not a information is created equal. Charlatans and fools can speak as loudly as saints o Nobel prize winners. The trick when evaluating the mountain of verbiage we all ar exposed to is to separate the nourishing wheat from the expendable chaff. One way t become good at doing this is to think a bit about what makes reasoning good (cogent as opposed to bad (fallacious).

1. Reasoning and Arguments

Here is a simple example of reasoning about the nature/nurture issue:

> Identical twins sometimes have different IQ test scores. Yet these twins inher exactly the same genes. So environment must play some part in determining person's IQ.

Logicians call this kind of reasoning an **argument**. In this case, the argument consists of three statements:

1. Identical twins often have different IQ test scores.
2. Identical twins inherit the same genes.
3. So environment must play some part in determining IQ.

The first two statements in this argument give *reasons* for accepting the third. In logic talk, they are said to be **premises** of the argument; and the third statement, which asserts the *claim* made by the argument, is called the argument's **conclusion**.

In everyday life, few of us bother to label premises or conclusions. We usually don't even bother to distinguish one argument from another. But we do sometimes give clues. Words such as *because*, *since*, and *for* usually indicate that what follows is a premise of an argument. Terms like *therefore*, *thus*, *consequently*, and *so* generally signal conclusions. Similarly, expressions such as "It has been observed that . . . ," "In support of this . . . ," and "The relevant data are . . ." are used to introduce premises, while expressions such as "The point of all of this is . . . ," "The implication is . . . ," and "It follows that . . ." are used to signal conclusions. Here is a simple example:

> *Since* it's always wrong to kill a human being (premise), *it follows that* capital punishment is wrong (conclusion), *because* capital punishment takes the life of (kills) a human being (premise).

Put into textbook form, the argument looks like this:

1. It's always wrong to kill a human being.
2. Capital punishment takes the life of (kills) a human being.

∴3. Capital punishment is wrong.*

Of course, an argument may have any number of premises and may be surrounded by or embedded in other arguments or extraneous material.

In addition to using transitional words like *since*, *because*, and *therefore*, we sometimes employ sentence order—the last sentence in a series stating an argument's conclusion—and occasionally even express a conclusion in the form of a question. During the 1992 presidential election, for example, a Democratic party spokesperson gave all sorts of reasons for believing that, if elected, Bill Clinton would push Congress into passing a health care reform bill and then stated his conclusion in the form of a rhetorical question: "Can anyone doubt, then, that Bill Clinton will succeed in reforming health care in America?"

We should also note that, in daily life, premises and even the conclusions of arguments sometimes are omitted as understood. Life is short, and we don't always bother to spell out matters that are obvious or not at issue or can be taken for granted. In the IQ example given earlier, for instance, the premise that IQ differences must be due either to genetic or to environmental factors was omitted as generally understood. When assessing arguments, we should by all means add omitted premises of this kind when they are relevant.

*The symbol "∴" often is used as shorthand for the word *therefore* and thus indicates that a conclusion follows.

EXERCISE 1-1

Identify the premises and conclusions in the following arguments (the last five are from student exams—modestly edited):*

Example:

Argument

The barometer is falling sharply, so the weather is going to change.

Argument Structure

Premise: The barometer is falling sharply.

Implied Premise: Whenever the barometer falls sharply, the weather changes.

Conclusion: The weather is going to change.

1. Thomas Szasz: Since there are no mental diseases, there can be no treatments for them.
2. *Chicago Daily News:* If marriages were really falling apart, divorced persons wouldn't be as eager as they are to find another partner as speedily as possible.
3. *The Economist:* It is difficult to gauge the pain felt by animals because pain is subjective and animals cannot talk.

*4. William Shakespeare: Forbear to judge, for we are sinners all.

5. Aristotle: The Earth has a spherical shape. For the night sky looks different in the northern and the southern parts of the earth, and that would be the case if the earth were spherical in shape.

*6. Marijuana has many medical benefits. It is significantly less harmful than many legal drugs. It should be legalized.

7. We should not judge Dr. Kevorkian guilty of murder. Murder should be defined so that it is committed only when you take the lives of people against their will or help those who are healthy to commit suicide. Dr. Kevorkian helped terminally ill patients who wanted to die rather than to suffer needlessly.
8. America is a society that values its freedoms. Censorship clearly has no place in a society that values its freedoms. It curtails independent thought, and discourages people from examining societal problems.

*9. No, I was not prepared to take this critical thinking class. How can you expect me to understand the material when I never heard of most of the people and events you talk about in class? And that textbook is just way over my head talking about people and events I've never heard of. What *did* happen at Watergate and who *is* Frank Lloyd Wright anyway? Have I proved my point? I was not prepared!

10. Yes, without a doubt the author of our textbook is prejudiced. You can tell because he uses all those examples against Ronald Reagan, Richard Nixon

*Starred (*) items are answered in a section at the back of the book.

those most difficult to please in all other matters do not commonly desire more of it than they already possess.

11. Kurt Vonnegut, *Jailbird:* There was no European language that Ruth could not speak at least a little bit. She passed the time in the concentration camp, waiting for death, by getting other prisoners to teach her languages she did not know. Thus did she become fluent in Romany, the tongue of the gypsies.

12. Michael H. Hart: It is worth noting that over the past fifteen years—a period during which U.S. women began using the pill regularly—the life expectancy among U.S. women has *increased* significantly. That fact alone should make it obvious that the pill is not a *major* health hazard.

2. Cogent Reasoning

Reasoning can be either *cogent* (good) or *fallacious* (bad). We reason **cogently** when we have satisfied the following conditions:

1. The premises of our reasoning are **believable** (**warranted**, **justified**), given what we already know or believe
2. We have considered all likely relevant information*
3. Our reasoning is **valid**, or **correct**, which means that the premises we employ provide good grounds for accepting the conclusion we have drawn†

When all three of these conditions of cogent reasoning are not satisfied, reasoning is said to be **fallacious**.

Note, by the way, that in daily life, we often speak of *arguments* as being fallacious or cogent, even though, strictly speaking, it is reasoners—individuals—who reason either fallaciously or cogently. Life is short and we often speak imprecisely when context makes clear what is intended.

Believable Premises

The first condition of cogent reasoning requires that we bring to bear whatever we already know or believe—our relevant **background beliefs** and information—to determine whether we should or shouldn't accept the premises of an argument being evaluated. Take, for instance, the first premise of the capital punishment argument discussed earlier, the premise making the claim that taking the life of a human being always is wrong. Most of us are not pacifists—we don't believe that it always is wrong to take a human life. Bringing that background belief to bear thus should make us see the first premise of the capital punishment argument as *questionable*. So we should not accept the conclusion of that argument unless further reasons are presented in its support.

By way of contrast, consider the stated premise of the following argument:

> Paul McCartney must be a heck of a good musician. After all, he was one of the four Beatles. (The implied premise is that anyone who was a member of that great rock group must be a very good musician.)

Virtually every pop music fan (not to mention almost everyone else with ears) knows very well that McCartney was a member of the Beatles, so for them, this argument's stated premise (that McCartney was one of the four Beatles) is warranted by plenty of background information.

It's interesting to notice that, in effect, evaluating a premise of an argument by bringing background beliefs to bear entails constructing another argument whose conclusion is either that the premise in question is believable or that it isn't. For example, when evaluating the capital punishment argument discussed before, someone who is not a pacifist might construct the following argument: "I believe that it isn't wrong to kill in self-defense, or in wartime, or to kill those guilty of murder. So I should reject the premise that taking a human life always is wrong."

This brings to mind the fact that in daily life we often are exposed to **assertions**, or **claims**, that are not supported by reasons or arguments. Clearly, it is not rational to accept these assertions without evaluating them for believability, and, obviously, their correct evaluation requires us to do exactly what we do when evaluating the believability of the premises of an argument, namely, bring to bear what we already know or believe. Evaluating unsupported assertions thus involves just part of what is done when we evaluate arguments.

No Relevant Information Excluded

The second criterion of cogent reasoning requires that we not pass over relevant information. In particular, it tells us to resist the temptation to neglect evidence contrary to what we want to believe.

Consider the following argument, voiced many years ago, and very much like ones we all have heard many times since then:

> We absolutely must start cutting down on the use of oil as an energy source. The World Resources Institute estimates that at the present rate of consumption, known reserves will be used up in just a bit more than 30 years.

Even supposing the institute's estimate had been on target, their reasoning still would not have been cogent, because it suppressed relevant information that most knowledgeable people have been well aware of all along—information that the World Resources Institute experts can be expected to have known about. Scare stories about running out of oil have circulated for at least fifty years now, but in spite of ever-rising consumption, known reserves continually increase anyway because new oil fields continue to be discovered. Prospecting for oil is expensive and chancy, so that when oil is a glut on the market (the usual situation over the years), exploration slows down; when reserves become lower relative to demand, exploration increases. That is why oil prices, excluding taxes and adjusted to account for inflation, are lower now than they were even in the 1930s. (Note, by the way, that only a few of the likely places to find

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*Satisfying this extremely stringent requirement is usually beyond the ability of most of us most of the time. The point is that good reasoners try to come as close as possible to satisfying it, taking into account the importance of drawing the right conclusion and the cost (in time, effort, or money) of obtaining or recalling relevant information. (One of the marks of genius is the ability to recognize that information is relevant when the rest of us fail to notice.)

†Provided we know nothing else relevant to the conclusion. Note that reasoning from an *unjustified* premise may still be cogent if it also employs justified premises that sufficiently support its conclusion. Note also that the term *valid* sometimes is used more broadly than we have used it here. For a more comprehensive account of valid reasoning, see Howard Kahane and Paul Tidman, *Logic and Philosophy*, 8th edition (Belmont, Calif.: Wadsworth, 1998).

oil have been thoroughly explored so far, and that even without direct efforts to reduce consumption of oil products.)

There are two morals to be drawn here. First, when we neglect relevant evidence, we do not reason cogently. Second, those who don't realize, or suspect, that relevant information has been passed over are fair game for more knowledgeable, less principled operators. Contrary to the old saying, what you don't know *can* hurt you.

Valid Reasoning

The third criterion of cogent reasoning requires that the premises of an argument genuinely support its conclusion; or, as logicians like to say, it requires that an argument be *valid*, or *correct*. It is vitally important to understand that the validity of an argument has nothing whatever to do with the truth of its premises or conclusion. Validity concerns the nature of the *connection* between the premises and conclusion of an argument, not the truth or believability of its premises. Determining that an argument is valid tells us that *if* we are justified in believing in its premises, *then* we also are justified in believing in the truth of its conclusion. It doesn't tell us *whether* its premises are true. An argument thus can be perfectly valid and have completely false premises, and even have a false conclusion. Here is an example:

1. The Cleveland Indians have won more world series games than any other major league team. (False premise, alas!)
2. So they have won more world series games than the New York Yankees. (False conclusion.)

The argument is valid because if the beloved Indians *had* won more games than any other major league team, then, obviously (well, it's obvious to baseball fans), they *would have* won more world series games than the Yankees. The argument is valid, even though its premise and conclusion both are false. It's valid because anyone who is justified in believing its premise *thereby* is justified in believing its conclusion.

3. Two Basic Kinds of Valid Arguments

There are two fundamentally different ways in which premises may correctly support conclusions. The first way yields *deductively valid* arguments; the second *inductively valid* (or *inductively correct* or *strong*) arguments.*

The fundamental property of a **deductively valid argument** is this: If all of its premises are true, then its conclusion *must* be true also, because the claim asserted by its conclusion already has been stated in its premises, although usually only implicitly.

Here is an example of a very simple deductively valid argument:

*Some authorities believe that there is at least one other kind of legitimate argument, namely, the kind in which various alternatives are evaluated. The authors of this text incline to the view that evaluative arguments fall into one or the other of the two basic kinds about to be mentioned. Note also that some authorities restrict the use of the term *valid* so that it refers only to *deductively* good arguments, even though in everyday life inductively strong arguments generally are said to be valid. In addition, note that the reasoning process called "mathematical induction" happens to be a kind of deductive reasoning. (Terminology sometimes is misleading.)

> Everything made of copper conducts electricity. (Premise)
> This wire is made of copper. (Premise)
> This wire will conduct electricity. (Conclusion)

Taken alone, neither premise makes the claim that the wire will conduct electricity; but taken together, they do, although not explicitly. We cannot imagine what it would be like for both premises of this argument to be true and yet its conclusion turn out to be false. Indeed, it would be contradictory to assert both of its premises and then to deny its conclusion.

Note again that the validity of an argument concerns the nature of the *connection* between the premises and conclusion of an argument, not the truth or believability of its premises. Determining that an argument is deductively valid thus tells us just that *if* its premises happen to be true, *then* its conclusion must be true also; it doesn't tell us *whether* its premises are true.

Here, for instance, is a deductively valid argument that contains one true and one very likely false premise and thus does not guarantee the truth of its conclusion:

> If more people read Agatha Christie's mystery novels than read Shakespeare's plays, then her novels must be better than his plays. (False premise?) And her novels are in fact read by a lot more people than read Shakespeare's plays. (True premise) So her novels must be better than his plays. (False conclusion?)

Of course, a deductively valid argument that contains a false premise may, luckily, have a true conclusion. But that would be a matter of luck, not of good reasoning.

The fact that a deductively valid argument cannot move from true premises to a false conclusion constitutes its chief characteristic and primary virtue. But deductive arguments are limited. They cannot yield conclusions that are not implicit (or explicit) in the premises from which they are derived. *Inductive* reasoning is needed to perform this task.

Inductively valid, or **correct**, **arguments**, unlike deductively valid ones, have conclusions that go beyond what is contained in their premises. The idea behind valid induction is that of *learning from experience*. We often observe *patterns*, *resemblances* and other kinds of *regularities* in our experiences, some quite simple (sugar sweetening coffee), some very complicated (objects moving according to Newton's laws—well Newton noticed this, anyway). Valid inductions simply project regularities of this kind noticed in our experiences so far onto other possible experiences.*

Here is a simple example of an inductively valid argument of the kind sometimes called *induction by enumeration*:

> I loaned my friend $50 last November and he failed to pay me back. (Premise) I loaned him another $50 just before Christmas, which he hasn't paid back (Premise), and yet another $25 in January, which is still unpaid. (Premise) I suppose it's time to face facts: He's never going to pay me back. (Conclusion)

We use inductive reasoning so frequently in everyday life that its nature generally goes unnoticed. Being informed about induction is a bit like being told that we've been speaking prose all our lives. We start drawing perfectly good inferences of this kind (and some klinkers) at a very early age. By age five or six, the use of induction

*As well as those experiences we can't have, but might have if we had lived millions of years ago or if, say, we could go into the interior of the sun without being incinerated.

has taught us a great many of the basic truths that guide everyday behavior—for instance, that some foods taste good and some don't, the sun rises every morning and sets every evening, very hot things burn the skin, some people are trustworthy and some aren't, and so on.

The great virtue of inductive reasoning is that it provides us with a way of reasoning to genuinely new beliefs, not just to psychologically new ones that are implicit in what we already know, as in the case of valid deductions. However, this benefit is purchased at the cost of an increase in the possibility of error. As remarked before, the truth of the premises of a deductively valid argument guarantees the truth of its conclusion; but the premises of a perfectly good induction may all be true and yet its conclusion be false. Even the best "inductive leap" may lead us astray, because the patterns noticed in our experiences up to a given point may not turn out to be the exact patterns of the whole universe. This happens all too often in daily life—for example, when a restaurant that has served excellent food many times in the past fails us on a special occasion. But it sometimes happens even in the lofty realm of theoretical science. Physicists, for instance, believed for a long time that asbestos does not conduct electricity—a belief supported by very good, very strong, inductive arguments—but then discovered that all substances, including asbestos, conduct electricity when cooled down close to absolute zero.

Nevertheless, rational people use induction in formulating their ideas about how things are going to turn out, whether in ordinary, everyday circumstances or in the rather special ones scientists bring about in the laboratory. Induction, to paraphrase Winston Churchill's famous remark about democracy, is the worst way to expand one's knowledge except for all of the other ways (guessing, wishful thinking, astrology, and so on).

4. Deductive Validity and Invalidity

Different arguments may have the same **form**, or **structure**. Here are two arguments that have the same form:

(1) 1. If it's spring, then the birds are chirping.
2. It is spring.
∴3. The birds are chirping.

(2) 1. If a world government doesn't evolve soon, then wars will continue to occur.
2. A world government isn't going to evolve soon.
∴3. Wars will continue to occur.

And here is the form or structure they share:

1. If [some sentence] then [a second sentence].
2. The first sentence (or a grammatical variant).
∴3. The second sentence (or a grammatical variant).

Or, using *A* and *B* to stand for the two sentences, respectively:

1. If *A* then *B*.
2. *A*.
∴3. *B*.

This deductively valid form is traditionally called **modus ponens**.

Now, here is another commonly occurring form, called **modus tollens**, that also is deductively valid:

Form:
1. If *A* then *B*.
2. Not *B*.
∴3. Not *A*.

Example:
1. If it's spring, then the birds are chirping.
2. The birds aren't chirping.
∴3. It isn't spring.

Here is another commonly occurring deductively valid argument form, usually called **hypothetical syllogism**:

Form:
1. If *A* then *B*.
2. If *B* then *C*.
∴3. If *A* then *C*.

Example:
1. If we successfully develop nuclear fusion power, then power will become cheap and plentiful.
2. If power becomes cheap and plentiful, then the economy will flourish.
∴3. If we successfully develop nuclear fusion power, then the economy will flourish.

And here is the deductively valid form called **disjunctive syllogism**:* disjunction =

Form:
1. *A* or *B*.
2. Not *A*.
∴3. *B*.

Example:
1. Either Dole won in 1996 or Clinton did.
2. Dole didn't win.
∴3. Clinton did.

Finally, here are several argument forms of a different kind (all but the first two are called **syllogisms**):†

Form:
1. No *F*'s are *G*'s.
∴2. It's false that some *F*'s are *G*'s.

Example:
1. No police officers accept bribes.
∴2. It's false that some police officers accept bribes.

Form:
1. All *F*'s are *G*'s.
∴2. If this is an *F*, then this is a *G*.

Example:
1. All salamis are tasty.
∴2. If this is a salami, then it is tasty.

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*Strictly speaking, in spite of their names, *disjunctive syllogism* and *hypothetical syllogism* are not syllogisms.

†See the Appendix and also Howard Kahane and Paul Tidman, *Logic and Philosophy*, 8th edition (Belmont, Calif.: Wadsworth, 1998) for additional material on deduction and induction.

Form: 1. All *F*'s are *G*'s.
2. All *G*'s are *H*'s.
∴3. All *F*'s are *H*'s.

Example: 1. All TV evangelists have high moral standards.
2. All who have high moral standards live up to those standards.
∴3. All TV evangelists live up to high moral standards.

Form: 1. All *F*'s are *G*'s.
2. This is an *F*.
∴3. This is a *G*.

Example: 1. All elected officials always tell the truth.
2. Bill Clinton is an elected official.
∴3. Bill Clinton always tells the truth.

Form: 1. All *F*'s are *G*'s.
2. No *G*'s are *H*'s.
∴3. No *F*'s are *H*'s.

Example: 1. All males are chauvinist pigs.
2. No chauvinist pigs are likeable.
∴3. No males are likeable.

Form: 1. No *F*'s are *G*'s.
2. Some *H*'s are *F*'s.
∴3. Some *H*'s are not *G*'s.

Example: 1. No foreigners can be trusted.
2. Some newborn babies are foreigners.
∴3. Some newborn babies cannot be trusted.

Deductive Invalidity

Any argument that doesn't have a deductively valid form is said to be **deductively invalid.*** The number of deductively invalid argument forms is legion, but a few occur so frequently that they've been given names. Here are two examples (to give the flavor):

Fallacy of denying the antecedent:

Form: 1. If *A* then *B*.
2. Not *A*.
∴3. Not *B*.

Example: 1. If abortion is murder, then it's wrong.
2. But abortion isn't murder.
∴3. Abortion isn't wrong.

The conclusion doesn't follow: Even supposing abortion isn't murder, it may be wrong for other reasons.

Fallacy of asserting the consequent:

Form: 1. If *A* then *B*.
2. *B*.
∴3. *A*.

*A deductively invalid argument may still be a good argument if it is inductively correct. Arguments that have the forms about to be discussed are bad because they are neither deductively valid nor inductively correct.

Beetle Bailey. Reprinted by permission of King Features Syndicate, Inc.

Humorous use of disjunctive syllogism. General Halftrack's reasoning is this: Either the box is too small or we're not running this camp right. But it's false that we're not running this camp right. So the box is too small. Build a bigger one. Just as we often do in daily life, Halftrack omits a premise as understood, namely, the premise that it's false that the camp is not being run right.

Example: 1. If Reagan is still president, then a liar is now president.
2. A liar is now president.
∴3. Reagan is still president.

The conclusion doesn't follow: Some other liar may now be president.

Exercise 1-3

Invent deductively valid arguments having the forms *modus ponens*, *modus tollens*, *disjunctive syllogism*, and *hypothetical syllogism*. Then invent arguments having the forms of the fallacies *denying the antecedent* and *asserting the consequent*, and show that they are deductively invalid by explaining how their premises might be true when their conclusions are false.

5. Inductive Validity (Correctness) and Invalidity (Incorrectness)

As indicated before, we can think of induction as a kind of patterning. Perhaps the simplest form of induction is the one called **induction by enumeration**, previously mentioned. In this form of inductive reasoning, we infer from the fact that all *A*'s observed so far are *B*'s to the conclusion that all *A*'s whatsoever are *B*'s. For example, a study of 100 members of Congress no doubt would show that they all accept campaign contributions from lobbyists intent on influencing legislation, and finding this out would count as good evidence for the inductive conclusion that *all 535* members of Congress accept funds of this kind.

Obviously, some inductions of this kind are better than others and make their conclusions more *probable*. While there are several interesting theories about how to determine the probability of the conclusions of inductive arguments by enumeration, almost all agree on a few points.

Greater sample size yields greater probability. The more instances in a sample (the instances observed so far), the greater the probability of a conclusion based on that

sample. A sample of 100 members of Congress who accept campaign contributions from lobbyists provides a higher degree of probability that all do than a smaller sample, say, of 50 members. The point is that more of the same sort of evidence doesn't change the conclusion of an induction; rather it changes the degree of probability of that conclusion, and thus changes the strength of belief a rational person should have in it.

More representative samples yield higher probabilities. The quality of a sample is even more important than its size. (Indeed, the higher its quality, the smaller a sample needs to be to yield a given degree of probability.) When sampling apples in a barrel, for instance, it won't do just to sample a few from the top (the classic case); after all, rotten apples are more likely to be at the bottom than at the top of a barrel. Samples that neglect possible rotten apples at the bottom of metaphorical barrels are said to be *biased*. Obviously, less biased, more *representative* samples yield higher degrees of probability for the conclusions drawn from them.

One definite counterexample shoots down an enumerative induction. The most important reason that inductive reasoning is superior to many other kinds (for example, of the superstitious or the pseudoscientific kinds to be discussed later) is that it does not allow us to pass over evidence that indicates a pet theory is false. For example, if one woman who takes a birth control pill as directed gets pregnant, then no valid enumerative induction about the pill's effectiveness can be drawn. (Note that it still may be possible to draw other kinds of valid inductive inferences, including the statistical kind to be discussed shortly.)

However, it often is hard to be sure that what looks like a counterexample really is one. A woman on birth control pills who becomes pregnant, for instance, may have accidentally neglected to take the pills properly, and we may not be aware of that fact. The moral is that it is risky to reject an enumerative induction on the basis of one counterexample, or even two, unless we are very sure that at least one is a genuine counterexample. But when we are sure, then an enumerative induction in question must be rejected.

Reasoning by Analogy

Several other kinds of inductive reasoning are very similar to enumerative induction, including reasoning by **analogy**. In one version of this kind of inductive reasoning, we reason from the similarity of two things in several relevant respects to their similarity in another. Thus, if we know that two people have similar tastes in books, art, food, music, and TV programs, and find out that one likes to watch *Mystery!* on public television, we're justified in concluding by analogy that the other probably does also.

The trouble is that every two things resemble each other in an indefinitely large number of ways. Only *relevant* resemblances count in drawing correct analogies. But what makes a resemblance relevant? The answer is background beliefs about how, in general, things hang together. For example, if the stock market rises and falls in concert with ups and downs in the Olympic elk population over several years, only fools are likely to conclude that the two will fluctuate together in the future, because so much background information contradicts this idea. On the other hand, if stocks were to rise and fall over several years in concert with ups and downs in retail sales, we could reason by analogy that the next change in one will produce a similar change in the other. (Of course, given all of the other factors relevant to stock market prices, an induction of the kind just described would have to be assigned a very modest degree of probability.)

In another version of analogical induction, we reason from the fact that all examined items of a certain kind have a particular property to the conclusion that a particular as yet unexamined item of that kind will be found to have that property. Finding out that, say, 100 members of Congress accept money from lobbyists, we can conclude by this kind of analogy that a certain other member probably also does so.

Analogical inductions are much safer, and thus have a higher degree of probability, than their enumerative counterparts, because they have much weaker conclusions. Concluding, for example, that a particular member of Congress accepts money from lobbyists is a much weaker, hence safer, prediction than that all members of Congress do so.

Statistical Induction

When drawing a sample from a population, we often find that not all of the examined *A*'s are *B*'s, so that we cannot draw a valid enumerative induction. But having found that a certain percentage of the *A*'s have the property in question, we can conclude by a **statistical induction** that the same percentage of the total population of *A*'s have that property. Having found, say, that 480 of the first 1,000 observed tosses of a given coin land face up, we can conclude that 48 percent of all of the tosses with that coin will land face up (thus learning, incidentally, that the coin probably is slightly biased in favor of tails, as many coins are).

Of course, what was said about the quality and, hence, the degree of probability of enumerative inductions also applies to the statistical variety. The larger the sample employed and the more representative it is, the higher the degree of probability of a statistical induction based on that sample.

Higher-Level Induction

More general, **higher-level inductions** can be used to evaluate those that are less general. For example, we use higher-level induction when we conclude that an automobile engine eventually will wear out or need to be repaired, even though it has run perfectly for 100,000 miles. We overrule a low-level conclusion telling us that because the car has run perfectly so far, it will do so forever, by appeal to a higher-level, more general, induction such as this one: All mechanical devices with moving parts checked up on so far have eventually worn out or needed to be repaired; so *very* probably this particular mechanical device (the engine in question) also eventually will need to be repaired.

More general inferences, based on larger samples about more kinds of items, usually have higher degrees of probability than do those that are less general. That is why an enumerative induction about a particular automobile is overruled by a more general one about many mechanical devices. (There are, in fact, even higher-level reasons for tossing out this low-level induction by enumeration—for example, scientific inductions concerning basic principles of physics and chemistry having to do with the effects of friction.)

Causal Connections

When we reason inductively, we often are looking for explanations, or **causes**. For instance, early investigators of the connection between cigarette smoking and lung cancer, emphysema, and heart disease wanted to determine by means of statistical

induction whether smoking *causes* these death-dealing diseases. They found that smokers contract these diseases much more frequently than nonsmokers, and heavy smokers more than light. That is, they discovered a statistical link between smoking cigarettes and contracting these diseases. Finding no higher-level evidence to the contrary, they concluded that cigarette smoking does indeed cause these life-threatening illnesses. (That some people smoke like chimneys and never come down with these illnesses doesn't prove the contrary, but it does suggest that part of the cause of these diseases must be some other, very likely genetic, factor.*)

The inductive patterns discussed in this chapter are relatively neat and simple. Enumerative induction is an example. But in daily life, and in particular in scientific theorizing, inductive reasoning often is much more complicated, and may involve mathematical reasoning (a kind of deductive reasoning) as well. We believe cigarette smoking causes lung cancer, for example, not just because a certain percentage of those who smoke get that deadly disease but also because the percentage of those who do not smoke and get lung cancer is much lower than for those who do smoke. It is the comparison of the two groups that proves the point. (See pages 83–84 for more on this point.)

Exercise 1-4

1. What is the difference between an *induction by enumeration* and *analogical reasoning*? Provide an example (not mentioned in the text) of each.
2. Explain in your own words what the difference is between an *induction by enumeration* and a *statistical induction*. Provide an example (not mentioned in the text) of a valid statistical induction.
3. What is meant by saying that an inference is a *higher-level induction*? Provide an example (not mentioned in the text).

Are Argument Validity and Cogency Relative?

Having just presented three standards of cogent reasoning and having explained the nature of valid deduction and induction, perhaps we need to mention several recently voiced ideas about logic and good reasoning. According to these trendy ways of looking at the topic, what counts as good reasoning is "culturally relative," or "gender relative," or even (popular among students) "individually relative." We hear talk of "feminine logic," supposedly different from the "male logic" taught in logic classes (often by female logicians, but let that pass), and of "black intelligence," different from the "Eurocentric" variety foisted on us by white males, as though what makes reasoning good differs from group to group, race to race, or one sex to the other. We all too often hear students say "That may well be true for you, but it isn't true for me"; and academics talk of "Aristotelian linear reasoning," as opposed to a more "intuitive" type of reasoning; and so on.

But there is no truth to these new ideas about what constitutes good reasoning. It is the height of folly to conclude, say, that *modus ponens* is not valid or that arguments having the form of the fallacy *asserting the consequent* are valid. Think, for example, what it means to seriously assert that all human beings have a right to life and then in the next breath, equally seriously, to claim that a particular human being, Smith, has no right to life. What sense is there in first saying that if Jones has been to China, then he's been to Asia, and then asserting that he has indeed been to China but not to Asia. Yet accepting reasonings that violate the standards of deductive logic means precisely accepting some sorts of contradictory assertions or other, because the point of the principles of valid deduction (including the valid principles of mathematics) is to assure that we do not contradict ourselves when we reason from one thing to another. (That's why, to take just one of a thousand examples, double entry bookkeeping works.)

*See the section in the Appendix concerning necessary and sufficient conditions.

"How can we know that no one can win a nuclear war unless we try it and see?"

Most readers of Playboy *magazine no doubt smiled when they read the caption under this cartoon. But few would have been able to explain the nature of the folly in the respondent's reasoning. He seems to assume that the only way to establish or justify factual beliefs is by low-level induction by enumeration (or perhaps by statistical induction)—trying out several nuclear wars to see whether any nation can win them. He overlooks higher-level induction (plus deductive reasoning), which many of us use to conclude that the destruction caused by an all-out nuclear war would leave neither side a winner.*

Similarly, what reason could there be for violating the standards of good inductive reasoning—for denying what experience teaches us? That a large majority of the scientists who laid the groundwork in physics, chemistry, and biology were white males is totally irrelevant to the truth of their basic ideas and theories. *The way the world works does not differ depending on the race or sex of those trying to discover the way the world works!*

That is why there simply is no truth whatsoever to the idea that standards of good reasoning differ from group to group, male to female, or person to person. There is, however, a good deal of truth to three somewhat different ideas. One is that self-interest and narrowmindedness frequently lead to reasoning that violates the standards of good reasoning; another is that self-interest often motivates us to neglect the values or interests of others, even when we share those values, so that some groups or individuals find their interests systematically ignored; the third is that the values and interests of one individual or group frequently conflict with those of another individual or group. In families where both parents work, for example, husbands notoriously tend to paper over their failure to share household and child-rearing duties; in the business world, high executives, while asserting their belief in equal rights for all, frequently overlook the ways in which women, or blacks, are passed over for corporate advancement; on Wall Street, rich investors care more for their own profits than for the interests of low-wage workers.

In all of these cases, the problem is not with the principles of good reasoning. It is with the fallacious nature of the ways in which these principles sometimes are employed—for example, when Western historians neglect evidence about the contributions of non-Western peoples; or with the use of different values in the premises from which reasoning starts—for instance, when male chauvinists reason from their belief in the inferior value of women compared to men; or with the self-interestedly motivated neglect of the interests of others—for example, when rich, well-fed officials ignore the plight of the poor and hungry at the bottom of the economic pecking order.

Those who champion other sorts of "logics" than the standard variety thus may well be mistaken in their target. They attack the principles of good reasoning rather than the failure of their opponents to correctly employ these perfectly good (indeed the only perfectly good) standards of reasoning, or rather than their opponents' differing political, or moral standards.

A good deal more will be said in later chapters on these matters. For now, the point is just that we must distinguish the principles of good reasoning, which are the same for all, from the ways in which these principles are employed (sometimes fallaciously), and from the differing values that enter into the premises of different reasonings.

6. Fallacious Reasoning: How Reasoning Goes Wrong

We said earlier that to be cogent, reasoning must satisfy three conditions. It must (1) start with justified premises; (2) include all relevant information; and (3) be valid. Reasoning that fails to satisfy all three of these criteria is said to be **fallacious**.

Consider, for instance, the following argument overheard in a restaurant:

> We don't yet know who committed this senseless and vicious crime, but we will know some day. The wheels of justice may sometimes turn slowly, but eventually, sooner or later, vicious criminals get caught and punished.

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Cast into textbook form, the relevant portion of the argument reads something like this:

1. Sooner or later, all vicious criminals get caught and punished.
∴2. Sooner or later, the person who committed this particular vicious crime will be caught and punished.

Put this way, the argument clearly is valid, indeed deductively valid: If something is true of all things of a certain kind, then it must be true of any particular thing of that kind. Nevertheless, those who are convinced by this argument reason fallaciously, because there is good reason for doubting its premise that all vicious criminals get caught sooner or later.* Let's call fallacies like this one by the name **questionable premise**.

Now consider the following headline on an American Automobile Association (AAA) advertisement:

OVER 23,000,000 CAN'T BE WRONG!
YOU OWE IT TO YOURSELF TO INVESTIGATE!

(The figure 23,000,000 refers to the number of AAA members.)

This time the error is not that of *questionable premise*. There were indeed over 23,000,000 AAA members. But the headline suppresses the fact (not mentioned anywhere in the body of the advertisement) that a large majority of motorists, lots more than 23,000,000, were not auto association members. Readers taken in by this advertisement who knew this suppressed fact, or should have suspected it, were guilty of fallacious reasoning. And let's say that those who neglect evidence in this way are guilty of the fallacy of **suppressed** (or **neglected**) **evidence**.

Finally, in a lighter vein, here is a portion of a discussion between a certain party and his aunt:

> *How:* You mean you take this horoscope business seriously?
> *Aunt:* Yes, of course. Don't you see how today's horoscope fits you to a T?
> *How:* Yes, but . . .
> *Aunt:* No buts. There must be something to horoscopes if this one fits you so well.

*This is true, at any rate, with respect to those who have paid the slightest attention to what goes on in the world. People who go through life with their eyes closed are another matter. If they accept the goody-goody idea that vicious criminals always get caught, they will not be guilty of fallacious reasoning in this case, but they still will have reasoned from a false premise to a false conclusion.

The form of Aunt's reasoning is this:

1. This horoscope fits you to a T.
2. Horoscopes in general must be accurate.

Put this way, it's clear Aunt's reasoning was fallacious. That one horoscope fits one individual on one occasion lends only the most insignificant amount of support to the idea that all, or even most, do so. A single instance rarely is sufficient to justify a generality, even though many such instances often do. (They do, for example, when we reason from the fact that in a great many cases sugar has sweetened coffee—and never has failed to do so—to the general conclusion that it will in every case.) So Aunt's argument doesn't provide sufficient evidence to justify acceptance of its conclusion. Her reasoning is *invalid*. So let's call the fallacy she has committed that of **invalid inference**.

A great deal more will be said about fallacious reasoning in Chapters 3, 4, and 5.

Exercise 1-5

1. Invent an argument that, were you to accept it as cogent, would make you guilty of the fallacy of *questionable premise*. Explain why acceptance of this argument would make you guilty of this fallacy.
2. Do the same with respect to the fallacy of *suppressed evidence*.
3. Do the same with respect to the fallacy of *invalid inference*.

Summary of Chapter 1

Reasoning is the essential ingredient in solving life's problems. This chapter discusses some of the fundamentals of good reasoning and presents an overview of the material to be covered later on the topic of reasoning well in everyday life.

1. Reasoning can be cast into *arguments*, which consist of one or more *premises* (reasons) offered in support of a *conclusion*. In real life (as opposed to in textbooks), arguments usually are not labeled and divided from surrounding rhetoric, nor are their premises and conclusions neatly specified. But clues generally are given. Words such as *because*, *since*, and *for* usually signal premises, and *hence*, *therefore*, and *so* conclusions. Remember, though, that not all groups of sentences form arguments. They may be anecdotes or other types of exposition or explanation.
2. Reasoning is either *cogent* (good) or *fallacious* (bad). Cogent reasoning must satisfy three criteria: It must (1) start with *justified* (*warranted*, *believable*) premises; (2) include all likely relevant information; and (3) be *valid* (*correct*).
3. There are two basic kinds of valid reasoning: *deductive* and *inductive*. The fundamental property of a *deductively valid* argument is this: If its premises are true, then its conclusion must be true also. This is so because the conclusion of a deductively valid argument already is contained in its premises, although usually implicitly, not explicitly. (Note that a deductively valid argument may have false premises. What makes it valid is that *if* its premises are true, then its conclusion must be also.)

   Unlike deductively valid arguments, those that are *inductively valid* (*correct*, *strong*) have conclusions that go beyond the claims made by their premises, projecting patterns stated in the premises onto additional cases.
4. Different arguments may have the same form, or structure. *Modus ponens*, *modus tollens*, *hypothetical syllogism*, and so on, are deductively valid argument forms. *Asserting the consequent* and *denying the antecedent* are deductively invalid argument forms.
5. There are several kinds of valid, or correct, inductions. One is *induction by enumeration*, in which we infer from the fact that all *A*'s observed so far are *B*'s to the conclusion that all *A*'s whatsoever are *B*'s.

   In general, the larger or the more representative a sample, the greater the probability of an induction based on it. Note that one definite counterexample invalidates an induction. (But we have to be sure that it really is a counterexample.)

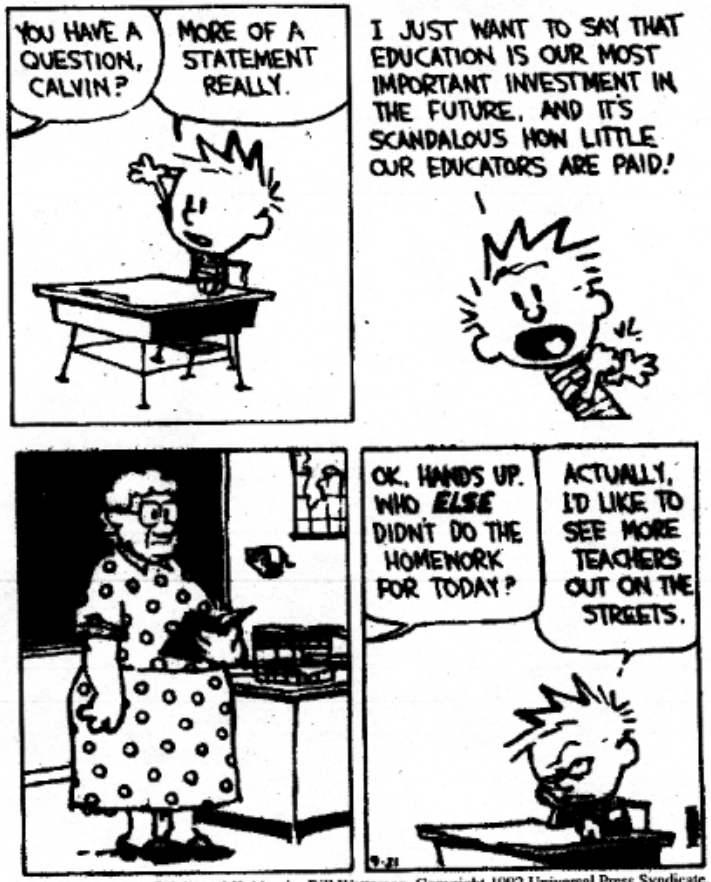
   Analogical reasoning is very much like induction by enumeration, the chief difference being that analogies yield conclusions about just one case (which is why they have higher degrees of probability than corresponding enumerative inductions), whereas enumerative inductions typically concern a great many.

   Statistical inductions also are similar to the enumerative variety, but move from the fact that a certain percentage of a sample has a given property to the conclusion that the same percentage in the population at large has that property.

   We can use more general, *higher-level* inductions to correct, or overrule, lower-level ones. If experience shows that all mechanical devices eventually wear out or need to be repaired, then it isn't reasonable to conclude that a particular engine will not, even though it has run perfectly for 100,000 miles.

   Inductive reasoning often is used to discover *causes*, as in the case of the statistical induction linking cigarette smoking and various life-threatening diseases.

   Note that there is no truth to claims about there being such things as "feminine logic" or "Eurocentric logic." Good reasoning does not differ from male to female, black to white, or in any way tied to ethnicity.
6. An argument is *fallacious* if either (1) its premises are not warranted; (2) relevant information has been passed over; or (3) the claims made by its premises do not justify accepting its conclusion (so that the argument is *invalid*). When a premise is not warranted, the fallacy is said to be that of *questionable premise*; when information has been overlooked, that of *suppressed* (*neglected*) *evidence*; when the argument is not valid, that of *invalid inference*.



Calvin is no match for Miss Wormwood, who easily reads between the lines of Calvin's attempt at ingratiation.