

# DIFFICULTIES IN EVERYDAY REASONING<sup>1</sup>

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## ABSTRACT

We report data arguing that difficulties in everyday reasoning reflect superficial mental models of situations more than logical fallacies. The naive reasoner has a "makes-sense epistemology" whose truth test is whether propositions make superficial sense. The sophisticated reasoner has a "critical epistemology," including skills for challenging and elaborating models of situations. A critical epistemology can and should be taught.

## REASONING

When one thinks of reasoning, it's natural to think of deduction. For those who have been thinking about deductive reasoning, it's not unnatural to think of some puzzle like this:

In a certain mythical community, politicians always lie, and nonpoliticians always tell the truth. A stranger meets three natives, and asks the first of them if he is a politician. The first native answers the question. The second native then reports that the first native denied being a politician. Then the third native asserts that the first native is really a politician. How many of these three natives are politicians? (Copi [1953], p. 16).

The philosopher Nelson Goodman invented the first truth-tellers-and-liars puzzle in 1931 (Goodman, 1972) and the many variants, including the one quoted here

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for its compactness, are problems in deduction. The information suffices, logically, to determine the answer. Of course, the charm of such problems lies in the seeming utter inadequacy of the information. We are not even told how the first native answered.

One of the ironies of reasoning is that in many everyday situations there seems to be a wealth of information. The man or woman on the street has had all sorts of practical experience with aspects of life such as raising children, buying cars, or voting for candidates for office. In the above puzzle there does not seem to be enough information, although there is; in everyday circumstances there *seems* to be a richness of information, but there is not. The everyday reasoner must wring whatever truth can be gotten from the knowledge at hand by weaving a kind of web of plausible conjectures that hangs together well enough to be worth believing in.

People are not very good at doing this, and that may matter a lot more than people not being very good at solving the above puzzle. Furthermore, it may be quite a different sort of activity. In the following pages, we will explore some possible differences between everyday reasoning and formal reasoning, provide some empirical evidence that those differences are not just plausible but actual, and then spend some time trying to characterize just what skillful informal reasoning involves.

A look at a hypothetical example will make a good beginning. One everyday issue used in a study of reasoning we are conducting was this: would a law requiring a five-cent deposit on bottles and cans reduce litter? A person carefully exploring the possible effects of such a law might reason as follows: (Indeed, each step below was mentioned by many subjects in our study, although no one subject explicitly reported all the steps.)

The law wants people to return the bottles for the five cents, instead of littering them. But I don't think five cents is enough nowadays to get people to bother. But wait, it isn't just five cents at a blow, because people can accumulate cases of bottles or bags of cans in their basements and take them back all at once, so probably they would do that. Still, those probably aren't the bottles and cans that get littered anyway; it's the people out on picnics or kids hanging around the street and parks that litter bottles and cans, and they sure wouldn't bother to return them for a nickel. But someone else might — boy scout and girl scout troops and other community organizations very likely would collect the bottles and cans as a combined community service and fund-raising venture; I know they do that sort of thing. So litter would be reduced.

Now it does not matter for present purposes whether one agrees with the conclusion; the point lies in the structure of the reasoning. Each sentence amounts to a challenge to the sentence before. We have here a series of objections to the argument so far, which present a series of difficulties in everyday reasoning. What is the nature of these difficulties? In complaining about lapses which are neither of deduction nor of probabilistic inference, each objection amounts to a challenge of some premise lying *behind* the previous statement. For example, to the proposition that people will return bottles and cans for five cents, the objection is that five cents will not persuade people to bother. The objection could be rephrased, "The law assumes that five cents is sufficient to motivate people to return bottles. But five cents isn't enough." The objection to that, in turn, is that people need not return their bottles one at a time, but would do so in batches. It could be rephrased, "In saying five cents isn't enough, I'd be assuming that people are returning bottles one at a time. Instead, people would probably return them in batches."

Such challenges to premises are interesting in several ways. First of all, in contrast with reasoning as classically conceived, premises change and accumulate as the argument proceeds, rather than being given at the outset. Second, the premises are somewhat constructive, elaborating the reasoner's understanding of the situation

rather than merely objecting. Third, these premises are very context specific. For instance, the judgment that five cents is or is not enough must take into account the reasoner's sense of how much of a nuisance returning a bottle is. Anyone will accede that people do many things for money — even minor amounts of money. But whether five cents is enough is to prompt most people to return bottles and cans cannot be decided by any such sweeping principle. Yet another curious feature is that these premises are not necessarily tightly held, although we usually think of premises being so. For instance, when it occurs to the reasoner that people might return their bottles and cans in groups, he quickly abandons the original image of people returning them one at a time.

In fact, at least in this made-up case, we might say that the reasoner is trying to construct a model of the phenomenon in question: the behavior of people if the deposit legislation were to be passed (Johnson-Laird, in press). As the reasoner proceeds, the model of the situation becomes more and more elaborated. Where the initial scenario has a faceless person returning a bottle for five cents, by the end we see household consumers of beverages accumulating their containers for return rather than discarding them. This of course, does not reduce litter since picnickers and kids are out in parks and on streets littering pretty much as usual. Boy scouts and other such groups are, however, collecting many of those bottles and cans. Perhaps to a considerable extent, difficulties in everyday reasoning are difficulties, not in the proper execution of inferences, but in the building up of an adequate model of the situation being reasoned about.

All this suggests a concept of sound reasoning very much at odds with sound reasoning as it has often been understood. The traditional study of logic and reasoning views premises as sacrosanct. They are the givens; proper reasoning is a matter of proper inference from those givens, and the adequacy of the givens is no proper concern of the study of reasoning. Matters are arguably nearly the reverse where everyday reasoning is concerned. Premises are not given — they must be generated by the reasoner. Proper reasoning, at least in the sense of effective reasoning, is very much a matter of adopting sound premises, and the adequacy of such premises certainly is a proper concern of the study of reasoning.

Reasonable as this may sound, it is a proposal that needs testing. Certainly there are other possibilities. Perhaps everyday arguments are riddled with cases of classical fallacies, to mention a few: affirming the consequent; arguing *ad hominem*; attributing collective properties of a group to its members individually; or contradicting oneself (Fearnside and Holther, 1959; Hamblin, 1970). Or perhaps the dominant difficulties concern errors of probabilistic inference, such as overgeneralizing from small sample sizes, or overweighting the significance of features supposedly representative of members of various classes (Tversky and Kahneman, 1971, 1974; Nisbett and Ross, 1980). What *sorts* of difficulties arise most often in everyday reasoning? This is an empirical question, a question to be answered by investigating such reasoning.

## METHOD

With the need to look at the natural phenomenon in mind, we undertook an empirical investigation of everyday reasoning. There follows a brief description of the approach.

### Subjects

There were six student subject groups and two nonstudent groups, each consisting of twenty males and twenty females. The student groups were drawn from

local medium-to-top rated universities, and high schools. They ranged from ninth-graders to fourth-year doctoral students. One nonstudent group consisted of nonstudents with college degrees, the other of nonstudents without college degrees.

### Procedure

Each subject participated in one session lasting over an hour. First, the subject was given an issue to think about, such as the deposit on bottles issue discussed earlier. After five minutes to ponder the issue and reach a tentative position if possible, the subject was asked to state the position and the reasoning behind it. Subjects who did not feel that they could reach a position were asked to explain the reasoning on both sides of the case that made this difficult. Then came a series of follow-up questions, focusing on some one reason the subject had mentioned, including such queries as, "How does your reason support your conclusion?" and "Can you think of any objections to your reason supporting your conclusion?" This entire process was then repeated for a second issue. Finally, each subject took a short form IQ test.

### Issues

Four issues were used in the study: 1. *Draft*. Would restoring the military draft significantly increase America's ability to influence world events? 2. *Television violence*. Does violence on television significantly increase the likelihood of violence in real life? 3. *Bottle bill*. Would a five-cent deposit on bottles and cans significantly reduce litter? 4. *Art*. Is the stack of bricks (by minimalist sculptor Carl Andre in London's Tate gallery) really a work of art? Each issue was presented on a typewritten sheet that expanded on the brief statement here. These issues were chosen from several piloted issues as ones that drew a variety of arguments and many advocates on both sides. The four cannot, of course, be considered an adequate statistical sample of the universe of everyday arguments. Such a sample would have to involve many more issues and would have generated far too much data to cope with. Instead, we tried to choose a set of issues that had currency and complexity, and that seemed likely to be reasonably representative of the sorts of everyday reasoning tasks people deal with.

### Scoring and Analysis

Using the data base described, we are investigating a number of questions: for instance, what sorts of reasoning do people use in everyday arguments? How do the kinds of arguments people make vary with education and IQ? And to what sorts of objections are everyday arguments subject? The latter, our operationalization of "difficulties in everyday reasoning," is the only one of concern here, and in the present paper we will only treat it in general, rather than in connection with different subject groups.

The objections analyzed came both from the subjects and the experimenters. First of all, each subject was asked to object to two aspects of his own argument during the follow-up questions for each issue. Second, depending on certain decision points in the interview, the experimenter often made an objection, a standardized one, if applicable, or else one conceived on the spot. Third, two investigators lis-

tened to a large sample of the tapes of the subjects' arguments and wrote down objections to the arguments they heard. This was a deliberately informal procedure. The investigators were not to try to impose any category system, but simply to respond in a natural manner of discourse, making whatever complaints seemed warranted.

Here a question arises: how can we be confident that the objections raised by the investigators are sound? The answer is that we cannot be fully confident of that. Indeed, we do not believe that the soundness of an objection to an informal argument can be defined in any more rigorous way than through the evaluation of other human judges, or through connoisseurship, so to speak. Nonetheless, there are grounds for proceeding. First of all, the investigators' objections are likely to be reasonably sound since the investigators were, by that point, much more familiar with the ins and outs of the issues than any subject. Second, we conjecture that the distribution of different kinds of objections is much the same for both sound and unsound ones. Third, during the further scoring, objections are being rated for their strength by an experimenter other than the one who generated them so it will be possible to compare distributions of high- and low-rated objections to determine whether any systematic differences occur.

The categorizing by two judges of a large sample of objections — about 2,000 — is now in progress. A classification system with fifty-five categories in five major divisions is being used and an adequate, although not very high, rate of interjudge agreement is being maintained. The results we will report are based on those objections classified alike by the two judges, which are, of course, those objections that have the clearest character. In this short space, it is not practical to describe the category system or even its general organization, but mentioning a few of the more self-explanatory category labels may help to give the flavor of the system: contradiction, begging the question, equivocation, counterexample, neglected critical distinction, *reductio ad absurdum*, small sample size, and biased sample. We will describe fully those categories that account for most of the objections. Although scoring is not yet complete, at this point we can identify those categories that are dominant.

### THE TROUBLEMAKERS

The scoring to date reveals that about eighty percent of the objections fall into only eight of the fifty-five categories. These categories individually account for from five percent to about twenty percent of the objections. No other category accounts for more than two percent. We will describe the eight "troublemakers" roughly in their order of frequency.

#### Contrary Consequent

An argument often is challenged by starting with the same situation — enactment of a draft, say — and reasoning to a "contrary consequent," or one inconsistent with the supposed consequent. For instance, someone might argue, "If we had the draft, this would strengthen the army and hence increase our influence on world events." People often object more or less as follows, "If we had the draft, people would resent being drafted and not serve well, so the army would not in fact become stronger." It's a requirement of the contrary consequent category that the objection not merely deny the original argument, but provide a substitute scenario, as in the above example.

### Contrary Antecedent

This objection amounts to saying that the supposed consequent of the argument is not, or not necessarily, a consequent of the argument at all, but instead a consequent of something else. For example, subjects occasionally argue, "People are watching more and more television and violence is on the upswing, so television violence increases real-world violence." To this, there is the objection, "There are many other possible causes for increasing violence—for instance, a lax judicial system." Accordingly, there is no justification for reasoning backwards from supposed effect to television violence as the cause. Contrary antecedent objections can also apply to arguments in the forward direction, from cause to effect. For instance, subjects often assert that "more people in the army will make the army stronger." We find the objection, "It's not number of personnel *at all* nowadays that makes armies stronger, but high technology and number of nuclear weapons." This objection denies that numbers lead to strength and reassigns the antecedent role to high technology and nuclear weapons.

### External Factor

Sometimes an objection holds that another intervening factor blocks or vitiates the inference, which is not denied as a general tendency, but denied in the case of concern, because of the external factor. For instance, people arguing the draft issue sometimes say, "We have a large population that would pull through in any military crisis." Objection: "A large population used to help, but today modern nuclear weapons can make short work even of a large population." Like contrary consequent objections, external factor objections aver that things will turn out otherwise than proposed in the target argument. Unlike contrary consequent objections, external factor objections identify an interfering factor not intrinsic to the hypothesized situation. Here, nuclear weapons are not caused by large populations, but, since they happen to be around, they can make short work of such populations.

### Disconnection

Sometimes people make arguments where the reasons seem to have nothing to do, or not enough to do, with the conclusion. It's not that there is a specific objection, like an external factor or an alternative inferential chain leading to a contrary consequent. Rather, the reasons just do not bear sufficiently. For example, "The percentage of litter varies from place to place, therefore, I have no grounds for deciding whether the bottle bill would significantly reduce litter." Objection: "There's no apparent reason why variation of litter from place to place should eliminate all grounds for deciding on the effects of the bottle bill." For another example, "The United States already has a lot of influence on world events, so a stronger army wouldn't give it any more." Objection: "Having lots of something doesn't in general imply that you can't have more of it."

### Scalar Insufficiency

Many arguments involve causal or other factors, and effects or other consequences, that are matters of degree. Sometimes the objection arises that there is an

insufficient degree of a factor for the consequent to follow, or for it to follow to the expressed degree. For an example already mentioned, people often object to the anticipated effects of the bottle bill on the grounds that "five cents isn't enough for people to bother with."

### Neglected Critical Distinction

The gist of this objection to an argument is as follows, "That may be true in general, but in this situation you're not distinguishing between certain relevant subclasses. In fact, the critical subclass is one you've overlooked, and it turns out contrary to the generalization." Such an objection often is used against the claim that people will return the bottle for five cents. It takes the form, "Many people may do so. But you have to distinguish between people consuming beverages in their homes and people on picnics, or bumming around the streets and parks. It's much less convenient for the latter to return the bottles, and they're the ones that do most of the littering anyway."

### Counterexample

This category carries its familiar meaning. It should be added that classes of cases as well as individual cases are scored as counterexamples. The objection that "the people in my class" or "the people in my state" don't, in fact, do such and such would be scored as a counterexample. However, counterexamples must be empirically grounded. The objection that people "would not do such and such" is simply a prediction, and would not be scored as a counterexample.

### Alternative Argument

This is a classification for a certain kind of objection to an objection. The new objection acknowledges the force of the original objection, but argues that the inference goes through on other grounds in any case. For instance, to the complaint that "Five cents isn't enough," people sometimes answer, "Probably not by itself. But a bottle bill and the associated publicity will make people more environmentally conscious, so they will be more careful about litter."

## THE TROUBLE WITH REASONING

The eight categories discussed above describe the sorts of objections that everyday reasoning, at least as sampled in our study, invites most often. We should caution that we view these categories, for the most part, as constructs of the experimenters designed to sort a body of data. These constructs have no necessary reality as guiding schemata in the minds of skilled reasoners. Nonetheless, the general nature of the troublemakers illuminates the nature of the difficulties people encounter in everyday reasoning. Perhaps the most important point is this: most of the objections extend the reasoner's current model of the situation being reasoned about. Recall that our made-up soliloquy in the introduction emphasized such objections. There, the question was raised whether they played a large, even a dominant, role

in difficulties in everyday reasoning. That question is answered here in the affirmative. Five categories — contrary antecedent, contrary consequent, external factor, neglected critical distinction, and alternative argument — all involve objections that introduce new causal chains or other major elements into the reasoner's model of the situation. Together, these account for nearly sixty percent of the objections categorized so far.

Scalar insufficiency is also a complaint about the reasoner's model, although a less revisionary one. Scalar insufficiency objects that a given model, while sound in principle, won't "run." For instance, the objection that "five cents is not enough" acknowledges that while, in principle, people might return their bottles for money, the five-cent reward isn't sufficient to set the scenario in motion. Such judgments, are, as discussed earlier, highly context-specific.

With the counterexample category, one might hope to get away from the context-specific considerations characteristic of the above categories. After all, counterexample is a favorite tactic of the philosopher and the mathematician in their dealings with highly abstract propositions. But nothing of the kind occurs. The sorts of counterexamples people offer tend to be finely tuned to the particulars of the reasoning situation. For instance, counterexamples are frequent in the art issue, where propositions that the stack of bricks is art because it is creative, or interesting to look at, or has symbolic significance, are met by complaints that much science is creative, construction sites are interesting to look at, and flags have symbolic significance, but none of these things is art.

The only frequent category of objections where rather general "logical" lapses appear is disconnection. For instance, there was the proposal that the United States could not get more influence via the draft because they already had a lot of influence. Such *non sequiturs* as these smack of failures to appreciate matters of meaning such as what "lots" does and does not entail. But the disconnection category accounts for only about ten percent of the objections so far scored. In summary, for the most part, objections in everyday reasoning involve elaborations of the model of the situation, scalar insufficiency judgments, and counterexamples, all rather context-specific. The picture is not one of lapses of deductive or inductive logic or probabilistic inference; rather the picture is one of a failure to use the context-specific knowledge people have to edit and evolve context-specific models that are not so subject to context-specific criticism.

### ON CONVERSION

There is a natural reservation about this conclusion that needs to be met. What if many of the weaknesses in the arguments could be described *either* as classical fallacies or by raising some model-based point? Then it might be said that our results merely reflect the experimenters' bias toward making a model-based complaint, rather than citing a fallacy when both were available. The experimenters did not have such a policy, so any such bias was spontaneous. But more to the point, we want to argue that, when both are available, the model-based complaint is the right one to make. It is the one that most accurately reflects the psychology of how errors arise in everyday reasoning.

The case can be made by examining a common and classical error of reasoning: "conversion" or "affirming the consequent." This error has the following form: A implies B; B; therefore A. Arguments that can be cast into such a form were mentioned earlier. They are frequent in the art issue, where subjects reason from attributes of art to the conclusion that the bricks are art. To recall the earlier example, "Art is creative. The stack of bricks is creative. So the stack of bricks is art."

But we want a theory of how errors arise psychologically. Do such arguments reflect an actual psychological step of conversion? When a subject says something like the above, we do not know exactly what has occurred psychologically. For instance, as many have pointed out, English is often ambiguous concerning whether "is" means if-then or if-and-only-if. The arguer may have intended "Art if-and-only-if creative" in the first place, advancing a faulty premise rather than converting. There are other simple courses of thought that might yield the same surface argument too. So with just the surface argument to judge from, we cannot tell whether the appearance of a conversion reflects an actual conversion step in the reasoning process.

But we do know something else very important: whatever the course of reasoning, the argument, as stated, is subject to complaints like, "You've said that the bricks are art because they're creative. But many things that are creative are not art — innovative scientific theories for instance." In other words, such complaints have nothing to do with exactly what faulty step is to blame.

Furthermore, what if no such objection could be found? What if neither a critic nor the original arguer could think of things that we consider creative but do not consider art? Then the seeming conversion would be acceptable. It would have passed muster by the context-specific test of whether the conversion works in the world as it is. True, a critic could still complain, "Just because everything around that's creative is art, that doesn't mean that everything possible that's creative would be art. You still haven't shown logical necessity." But the original arguer might say, "Acknowledged. But, after all, conditions for art are not given in advance here, but are at issue here. What better move than to find conditions that seem to have some empirical soundness and project them?" Indeed, experiments suggest that people who appear to make conversion errors on syllogisms often are doing exactly that (Staudenmayer, 1975). They tend to convert just when the situation posed by the syllogism makes conversion a good practical bet.

Are we saying that conversion is a legitimate inference? Of course not. The original if-then premise is never *grounds* for the backwards inference, but is, at best, an occasion for considering whether the backwards inference might hold. Rather, the point is that often the backwards inference may be judged to hold, and that whether it can be so judged soundly is the real issue in contexts of everyday reasoning. A reasoner who actually did convert frequently, but then always checked the model being evolved for its match with world knowledge, would not reach unsound conclusions, unless the situation were a strictly formal one where new premises could not be added. Furthermore, such a reasoner might be better off simply in generating many conversions for editorial consideration. After all, conversions often are good practical bets, and the reasoner who never pondered them out of formal fastidiousness would be likely to end up with weaker models.

In summary, although a conversion step in itself is always an error, the practical question is whether the reasoner is a good editor, expunging conversions that have no justification beyond the inadequate justification of the original premise. Because such editing has the last word, we suggest that seeming conversions in nonformal arguments, whether there was an actual psychological conversion step or not, should be understood as failures to check the inference against a good context-specific model of the situation. Thus model-retrieving and model-building appear paramount in practical reasoning.

### MAKES-SENSE EPISTEMOLOGY

In light of the foregoing, how should skilled reasoning be understood? What factors go into it? One such factor is a *large knowledge repertoire*. Clearly, the reasoner

busily assembling cogent models of situations must have a repertoire of knowledge to draw upon. Such a repertoire would include what the reasoner believes are facts about the world, and also a variety of causal schemata and scripts that the reasoner could weave together to build models of unfamiliar situations (Nisbett and Ross, 1980; Schank and Abelson, 1977).

Another contributor to skilled reasoning might be called *efficient knowledge evocation*. Merely having a repertoire of knowledge does the reasoner little good unless that knowledge is brought to bear. The normal psychological processes of pattern recognition and everyday understanding figure here. Some reasoners, pondering a situation, may find that models of the situation suggest themselves, while other reasoners draw a blank. Some may find that complications in a model already conceived occur to them spontaneously, while other reasoners display no such critical alertness. Furthermore, efficiency of evocation might turn out to be a meaningful parameter of cognitive functioning. Westcott (1968), attempting an operationalization of the concept of intuition, demonstrated that individuals varied considerably in their ability to reach correct conclusions on the basis of minimal evidence.

However, there is some reason for dissatisfaction with large knowledge repertoire and efficient knowledge evocation as a complete explanation for effective reasoning. For those who believe that reasoning is a special skill, there is nothing specific to reasoning about these traits. They would serve numerous other cognitive endeavors besides deciding about the truth of propositions by constructing arguments. The two traits are resources of understanding in general. Indeed, most of the time a large knowledge repertoire and efficient evocation do not at all feed the sorts of extended deliberative processes we have in mind when we think of reasoning. They simply function reflexively. One sees or hears and understands.

Instead, it's plausible that effective reasoning depends not solely on sufficient knowledge and efficient spontaneous knowledge evocation, but on an active effort to interrogate one's knowledge base in order to construct arguments pro and con. With this in mind, it's useful to have an idealized characterization of what naive reasoners do wrong. Naive reasoners might be said to have a "makes-sense epistemology." Of course, this does not mean that they have an explicit philosophy about what grounds are necessary for belief. But it does mean something in terms of manifested behavior: such reasoners act as though the test of truth is that a proposition makes intuitive sense, sounds right, rings true. They see no need to criticize or revise accounts that do make sense — the intuitive feel of fit suffices.

A makes-sense epistemology gives a unified picture of a wide range of findings about faulty reasoning. Concerning model building, for example, the simple account of the effects of the bottle bill where people return the bottles for the deposit "makes sense." So does the complaint that people won't, because the deposit is not enough. And so on through the example we began with. At each stage along the way the latest version makes sense — until a complication is introduced that qualifies it and develops the model further.

The same test of making sense accounts for other pitfalls of reasoning. Concerning *ad hominem* argument, it makes sense to assume that reprehensible people's reasons are also reprehensible. For another example, why doubt that small samples are representative of the classes from which they are drawn since it makes sense that samples should be typical of their parent classes (Tversky and Kahneman, 1971). And so on.

There is another, more psychological, way of characterizing a makes-sense epistemologist. Such a person reasons so as to minimize cognitive load. Simon (1947) has written about the limited rationality of the human reasoner. In the makes-sense epistemologist, that trait appears in pure form. Anything that com-

plicates the cognitive activity is shunned in favor of the simplest, most straightforward interpretation that seems to fit. Such a thinker's reasoning is dominated by a strategy of cognitive load minimization, rather than a strategy of truth-testing. Or perhaps it is careless to speak of a strategy. Perhaps this sort of behavior is simply a default condition.

It has to be understood that a makes-sense epistemology works rather well. It must, or there would be more environmental pressure on people to advance beyond it, and not so many people functioning as makes-sense epistemologists. In most situations, quick effortless understanding serves perfectly well. In situations not understood immediately, the first model we deliberately generate that makes sense often serves perfectly well. When it does not, and we are dealing with a situation in practical terms, we quickly discover that failing through experience. What matter if we could have found out the failing a little earlier through more careful thinking? The sort of probing, critical, comparative thinking that makes the very most of a person's knowledge resources is not usually needed. We value it for those occasions where it is.

### CRITICAL EPISTEMOLOGY

The notion of a makes-sense epistemology that minimizes cognitive load at the expense of truth-testing shows how far, short of sound reasoning, a large knowledge repertoire and even efficient evocation of knowledge can leave a thinker. With a makes-sense epistemology, a thinker will not be cultivating available knowledge resources, but simply letting them grow willy nilly into all sorts of careless beliefs, some of which of course will be pruned by later experiences. It's useful to have a contrasting characterization of an idealized skilled reasoner. This reasoner could be said to have a "critical epistemology." Where the makes-sense epistemologist is not really much of an epistemologist at all — there is no explicit theory of grounds for belief and the tacit theory is unsound — the critical epistemologist not only has an explicit theory, but a sound one. A critical epistemology might be described as follows.

#### Epistemological Realism

First of all, there would be an understanding of the pitfalls of justification. A critical epistemology includes knowledge of how common superficial fits between models and data really are, and how frequently more than one model fits the same situation. It includes other characteristic problems of the relation between evidence and theory too. For example, that small samples cannot be relied upon to give an accurate picture of their parent classes; or that chains of inferences, each of which has a probability somewhat less than one, cannot be confidently made, even if the links in the chain are all rather high probability ones. Reasoners with such knowledge could be said to be epistemological realists. Knowing the score, they have higher standards for the sorts of justifications they take as adequate.

#### Dialectical Style and Skills

With a critical epistemology should also come practical tactics and skills for developing sound models of situations. One of the most powerful of these tactics is

to ask the question, "What reasons are there why this model might fail" or, for short, "Why not?" (Perkins, in press). Asking "Why not?" runs absolutely contrary to the makes-sense epistemology, because it refuses to accept at face value what seems to be an adequate account. Instead of settling for the first decent fit, the "Why not?" tactic expects that a dialectical process of argument and counterargument will gradually evolve a more differentiated model. Of course, the "Why not?" question could lead to barren, nit-picking criticism. But it will not if the reasoner answers it in ways that improve the model, and so increase the reasoner's understanding of the situation.

### Formal Repertoire

Also not to be neglected in a critical epistemology is what might be called a formal repertoire. This means a knowledge of logical and heuristic forms that can be applied to the practical business of reasoning. For example, there is the propositional calculus, something that may see some use in informal contexts, although not very commonly. There is a *modus tollens* and *reductio ad absurdum*, which certainly do see many uses in informal contexts. Elementary statistical knowledge about sufficient sample sizes can help to guard against unwarranted inferences and may sanction warranted ones, and such knowledge is applicable in many informal contexts. Several heuristics may be helpful in decision-making situations, where the justification for one or another course of action consists in weighing gains and risks — a mini-max strategy, cost-benefits analysis, or minimizing maximum regret as reviewed by Hayes (1981), for example.

Our aim in introducing makes-sense and critical epistemologies and epistemologists has been to try to capture a couple of points about everyday reasoning that seem apparent from the results of these and other studies. First of all, not only formal reasoning but even everyday reasoning is a genuinely distinct skill. It is more than a matter of general mental ability, as reflected in a large accumulation of knowledge and efficient evocation. Most of all, it is a matter of working with and through a critical epistemology, a combination of understanding, style, and tactics that makes the most of the knowledge and knowledge-evoking powers the individual has.

Second, formal reasoning, as it has often been studied, and everyday reasoning are two rather different matters. A look at the features of a critical epistemology makes this clear. Where a critical epistemology involves critical realism, a person skilled in formal reasoning might know little about, for instance, the risks of statistical inference, or might have little appreciation of the looseness of fit between casual everyday theories and the experiential data for them, and how readily that looseness of fit leads to unwarranted beliefs. Where a critical epistemology involves a dialectical style and skills, the "Why not?" question is not such a crucial one in formal reasoning contexts. True, it is often the mission of the mathematician to seek counterexamples if something cannot be proven. On the other hand, once something appears to have been proven, seeking counterexamples or any sort of contrary argument is beside the point. One solid deductive chain is sufficient to establish a theorem.

But informal reasoning is utterly different. New premises, grounded in knowledge or causal schemes not previously invoked, can always enter the scene to challenge old ones. Furthermore, inferences are often probabilistic rather than deductive in character. Therefore, one sound justification — as sound as justifications get in everyday situations — by no means makes it pointless to ask the "Why not?" question, which therefore takes on a much more crucial role. As to formal

repertoire, the formal reasoner may have mastery of deductive forms, but heuristics such as minimizing maximum regret may be a worthwhile resource in everyday situations, where strict deduction is a rarity and the more esoteric syllogistic forms hardly ever appear.

A final point about a critical epistemology: if we are right in characterizing it as a matter of knowledge and know-how, it should be teachable. Teaching it would mean teaching something quite different from conventional logic or statistical inference, and also quite different from debate. To inculcate a critical epistemology would be to train people to build understandings of situations by interrogating their own knowledge, and playing off different sorts of knowledge and intuitions against one another in order to evolve sounder models. In short, it would be teaching an art and craft of understanding, a worthy enterprise if ever there was one.

### REFERENCES

- Copi, I.M. *Introduction to Logic*. New York: Macmillan, 1953.
- Fearnside, W.W. and Holther, W.B. *Fallacy: The Counterfeit of Argument*. Englewood Cliffs, NJ: Prentice-Hall, 1959.
- Goodman, N. "The Truth-tellers and the Liars." In *Problems and Projects*. Indianapolis, IN: Bobbs-Merrill Co., 1972.
- Hamblin, C.L. *Fallacies*. London: Methuen & Co., Ltd., 1970.
- Hayes, J.R. *The Complete Problem Solver*. Philadelphia: The Franklin Institute Press, 1981.
- Johnson-Laird, P.N. "Logical Thinking: Does it Occur in Daily Life? Can it be Taught?" In *Thinking and Learning Skills, Volume 2: Current Research and Open Questions*, S.S. Chipman, J.W. Siegel, & R. Glaser (Eds.). Hillsdale, NJ: Lawrence Erlbaum, in press.
- Nisbett, R. and Ross, L. *Human Inference: Strategies and Shortcomings of Social Judgment*. Englewood Cliffs, NJ: Prentice-Hall, 1980.
- Perkins, D.N. "General Cognitive Skills: Why Not?" In *Thinking and Learning Skills, Volume 2: Current Research and Open Questions*, S.S. Chipman, J.W. Siegel, & R. Glaser (Eds.). Hillsdale, NJ: Lawrence Erlbaum, in press.
- Schank, R., and Abelson, R.P. *Scripts, Plans, Goals and Understanding: An Inquiry Into Human Knowledge Structures*. Hillsdale, NJ: Lawrence Erlbaum, 1977.
- Simon, H.A. *Administrative Behavior*. New York: Macmillan, 1947.
- Staudenmayer, H. "Understanding Conditional Reasoning with Meaningful Propositions." In *Reasoning: Representation and Process in Children and Adults*, R. Falmagne (Ed.). Hillsdale, NJ: Lawrence Erlbaum, 1975.
- Tversky, A., and Kahneman, D. "The Belief in the Law of Small Numbers." *Psychological Bulletin*, 1971, 76, 105-110.
- Tversky, A., and Kahneman, D. "Judgment Under Uncertainty: Heuristics and Biases." *Science*, 1974, 185, 1124-31.
- Westcott, M.R. *Toward a Contemporary Psychology of Intuition*. New York: Holt, Rinehart, & Winston, 1968.