WHEN TO BE LOGICAL: AFFIRMING THE CONSEQUENT

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In ordinary matters people often reason in the following way: "If my hypothesis is correct, then certain results will occur. The results do occur; therefore, my hypothesis is correct." The following specific examples indicate how familiar the pattern is.

1) If the radiator is overheating, then the idiot light is on. The idiot light is on; therefore, the radiator is overheating.

2) If there is water in the mineshaft, then the stone will splash. The stone splashes; therefore, there is water in the mineshaft.

3) If God exists, my prayers will be answered. My prayers are answered; therefore, God exists.

A beginning logic student will recognize at once that these are all instances of the deductive fallacy of affirming the consequent. They are logically wrong, and should be dismissed, since it is possible in each case that the premisses are true while the conclusion is false. The fact that people do often reason this way presumably is no indication of the correctness of their reasoning. Perhaps when knowledge of formal logic becomes widespread, this form of reasoning will be abandoned.

On the other hand, it may be a mistake to insist on a strict formal interpretation of the above arguments. A pattern that is so widely used may have merit overlooked in a purely formal approach. Moreover, the pattern's occurrence is not limited to unsophisticated contexts.

In his introductory logic text, Irving Copi gives the following example as an instance of the kind of relation that is to be included under the heading of material implication: "If the blue litmus paper is placed in acid, then the litmus paper will turn red."[1] Let us imagine circumstances in which this statement would be appropriate. In a laboratory we might routinely satisfy our curiosity about the nature of a certain liquid by placing a piece of blue litmus paper in it. We observe that the paper turns red, and we conclude that the liquid is an acid. Again, in formal terms we would have affirmed the consequent, and so have propounded a fallacy.

Reichenbach in *The Rise of Scientific Philosophy* tells us that:

> Knowledge begins with observation . . . but we are not satisfied with what we observe; we want to know more, to inquire into things that we do not observe directly. We reach this objective by means of thought operations, which connect the observational data and account for them in terms of unobserved things. This procedure is applied in everyday life as well as in science; it is at work when we infer from puddles on the road that it rained shortly before, or when the physicist infers from the deflection of a magnetic needle that there is an invisible entity, called electricity, in the wire, or when the physician infers from the symptoms of a disease that there are certain bacteria in the blood stream of the patient.[2]

Consider the case of the physicist who infers from the deflection of a magnetic needle that there is a current in the wire. Again we can imagine circumstances in which this reasoning would be appropriate: "Is there a current in this wire? If there is a current, then the needle will be deflected. The needle is deflected; hence, there is a current in the wire." One might object that the order or the statements should be reversed; that a valid inference requires us to say that if the needle is deflected, then there is a current in the wire. But it is the presence of the current that is in question, not the deflection of the needle. Reichenbach is evidently thinking of the order we have proposed, since he uses the same example later in his book, giving it specifically as, "If an electric current flows through the wire the magnetic needle will be deflected."[3]

It should be noted that in the latter case Reichenbach is concerned with predictive knowledge, and regards the sample statement as a generalization from previous experience, rather than as the confirmation of an hypothesis concerning the presence of an electric current. On this interpretation it is not a deductive inference, but the application of a rule justified inductively. The truth of the consequent is merely another confirming instance in the induction. This is the standard interpretation of the pattern we are considering, and we do not intend to question its correctness. What is in question is the criterion which justifies this interpretation on some occasions, but not on others.

In discussing the general nature of scientific knowledge Philipp Frank observes that, "One reason for believing a statement is that we can derive results from it which can be checked by observation; in other words, we believe in a statement because of its consequences." He goes on to say that this is the " 'scientific criterion' in the modern sense."[4]

It appears that the pattern of ordinary reasoning noted at the beginning of this paper is found also in the more sophisticated realm of science. As Frank is quick to point out, scientific thinkers are well aware that the pattern can provide only confirmation and never proof of a hypothesis. Less knowledgeable users may not be as cautious in their claims.

The problem that these observations are intended to draw attention to can be simply stated. Given an argument of the form, "If p, then q; q, therefore p," how is one to judge whether it should be summarily dismissed as fallacious, or tentatively accepted as a confirming instance? In either case the form of the argument is exactly the same. As students of logic we have learned that when an argument has the same structure as an elementary argument form it can be regarded as a substitution instance of that form. Presumably, the rule applies to invalid forms as well. The arguments in question are substitution instances of the invalid elementary form known as affirming the consequent, and are, therefore, invalid. On the other hand, we recognize that in some cases arguments of the same form may be our best ground for accepting a hypothesis as true. As Frank observes, "We believe in Newton's laws because we can calculate from them the motions of the celestial bodies."[5]

Consider two of the examples introduced at the outset: "If there is water in the mineshaft, then the stone will splash," and "If God exists, then my prayers will be answered." Both are fallacious in exactly the same way, but the first argument is less easily dismissed than the second. The claim that there is water in the mineshaft because the rock splashed might be allowed to pass without objection, but the claim that God exists because prayers are answered is much less likely to be allowed. In the first case we might hesitate to invoke a strict formal interpretation of the argument. It would be picky to do so, even among people familiar with formal logic. On the other hand, in the second case we might insist on the formal interpretation as the most effective answer to any such claim.

The question that concerns us then becomes, "When should we be logical in a strict formal sense, and when should we suspend the strict application of the rules of deductive logic?" Whatever the criterion we chose for treating the arguments differently, or for deciding not to regard an argument in the given form as an instance of affirming the consequent, it clearly cannot be the form of the argument that serves as a basis for the decision. The conclusion that a wire is charged with an electrical current because a magnetized needle is deflected is no doubt an instance of induction, but it may appear in a form that is indistinguishable from the form of a familiar deductive fallacy. When arguments are presented in this ambiguous form, how are we to tell what standards are appropriate for their evaluation?

A related difficulty exists with the valid form of *modus tollens*. In order to avoid the uncertainty that attaches to inductive inference Karl Popper and others have maintained that the proper role of observation is not the verification of hypotheses, but rather their falsification. By negating the consequent and the conclusion in all our examples they would be rendered deductively valid. No hypothesis may be proved true by observations which affirm the truth of its consequences, but a hypothesis may be proved false by observations which negate its consequent. The difficulty is that in fact the hypothesis is never simple, and a single negative instance cannot be assigned with certainty to a specific antecedent. As a result, in

arguments dealing with matters of fact, the form may appear to be that of *modus tollens* without actually being so, since part of the hypothesis may be suppressed.

The conclusion to be drawn from the foregoing observations is that the rules of deductive logic cannot be automatically invoked to evaluate an argument, even when that argument is presented in a form that is indistinguishable from the elementary argument forms we have been considering. The form of the argument is a necessary condition for invoking the deductive rules, but it is by no means a sufficient condition.

The search for the sufficient conditions upon which to invoke the rules of logic can be regarded as a central issue in the philosophy of science, and perhaps in philosophy generally. If we could specify the conditions under which the rules of deductive logic are to be applied or withheld from the evaluation of reasoning we would have taken a long step toward justification of knowledge claims in science, and in other areas of experience as well.

Of course, one solution to the problem of when to be logical is to insist, as Wittgenstein does in the *Tractatus*, that no choice is possible. All meaningful discourse must be cast in logical form, since the propositions of logic represent the framework which supports all of our experience of the world. Thus it is always appropriate to invoke the rules of formal logic. Wittgenstein later acknowledged the difficulties involved in this view. Wittgenstein's own account of one incident that contributed to his rejection of his earlier position coincides nicely with the thesis of this paper. The anecdote recounted by Norman Malcolm in his brief memoir, tells how Wittgenstein, while expounding his views on logical form, was interrupted by a Cambridge friend who made a familiar gesture of disgust and asked, "What is the logical form of that?" The logical form of expressions is by no means obvious, even in those cases where the expressions and the elementary argument forms are isomorphic.

Support for this view is found also among those who believe in the fundamental rationality of science. For example, Imre Lakatos, who has attacked as irrational the theory that science proceeds by revolutionary stages, still concedes that there can be no instant rationality in science. No purely formal technique will serve to evaluate isolated theories. They can be judged only in terms of the entire program of which they are a part, and which are themselves evaluated by their results as well as by their form. Lakatos describes the situation this way:

> The direction of science is determined primarily by human creative imagination and not by the universe of facts which surrounds us. Creative imagination is likely to find corroborating novel evidence in even the most absurd program, if there is sufficient drive.... Scientists dream up fantasies and pursue a highly selective hunt for new facts to fit these fantasies.... A brilliant school

of scholars . . . might succeed in pushing any fantastic program ahead, or alternatively, if so inclined, in overthrowing any arbitrary chosen pillar of 'established knowledge.'[6]

For Lakatos the solution lies in the concept of a research program. The rules of rationality are to be applied strictly only to a total scheme as it has developed during an extended period. However, I believe that the solution to the problems we have been considering must include an explanation of the ways in which we classify and evaluate reasoning processes in ordinary circumstances and across the full range of cognitive experiences, including those that may have their origins in literature or the arts. Such a solution would amount to a "logic" of the development and use of language itself. In the absence of such a solution we conclude that the question of when to be logical remains unanswered.

NOTES

[1] Irving M. Copi, *Introduction to Logic*, 4th ed. (New York: Macmillan, 1972), p. 259.

[2] Hans Reichenbach, *The Rise of Scientific Philosophy* (Berkeley: University of California Press, 1961), pp. 176-77.

[3] *Ibid.*, p. 237.

[4] Philipp Frank, *Philosophy of Science: The Link Between Science and Philosophy* (Englewood Cliffs, N. J.: Prentice-Hall, 1957), p. 16.

[5] *Ibid.*

[6] Imre Lakatos, "Falsification and the Methodology of Scientific Research Programmes," *Criticism and the Growth of Knowledge*, ed. Imre Lakatos and Alan Musgrave (Cambridge: Cambridge Univ. Press, 1970), pp. 187-88.

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