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ON THE RELATION BETWEEN LOGIC AND THINKING

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The question of whether logic is descriptive of the thinking process, or whether its relation to thinking is normative only, seems to be easily answered. Our reasoning does not, for example, ordinarily follow the syllogistic form; and we do fall into contradictions. On the other hand, logic unquestionably provides criteria by which the validity of reasoning may be evaluated. Logical forms thus do not describe actual thinking, but are concerned with the ideal, with "how we ought to think." And yet a problem seems to be concealed beneath this easy solution.

It is interesting to note that a number of the older writers on logic regarded their discipline as the science of thought. It will not be possible here to survey the vast literature, some of which bears only by implication on our problem, but some examples will illustrate this position. Cohen and Nagel (1934) summarize the older view: "An old tradition defines logic as the science of the laws of thought" (p. 18). Kant (1885) holds that "logic is a science of the necessary laws of thought, without which no employment of the understanding and the reason takes place" (p. 3). Psychology, on the other hand, supplies only the contingent, not the necessary, rules of thought. John Stuart Mill (1874) likewise views logic as comprising "the science of reasoning, as well as an art, founded on that science" (p. 18). He continues:

> Whatever has at any time been concluded justly, whatever knowledge has been acquired otherwise than by immediate intuition, depended on the observance of the laws which it is the province of logic to investigate. If the conclusions are just, and the knowledge real, those laws, whether known or not, have been observed (p. 22).

Boole (1854), as a final instance, regards "the laws of the symbols of Logic" as "deducible from a consideration of the operations of the mind in reasoning" (pp. 45–46). Boole deduces the law of contradiction, for example, from a fundamental law of thought (pp. 49–51).

More recent writers, on the other hand, have tended to reject the view that the laws of logic are those of the human understanding. Again, only a few illustrations will be given. Cohen (1944) remarks:

> That the laws of logic are not the universal laws according to which we do actually think is conclusively shown, not only by the most elementary observation or introspection, but by the very existence of fallacies (pp. 2–3).

A similar point is made by Nagel (1956):

> Little need be said in refutation of the view that logical principles formulate the "inherent necessities of thought" and are generalized descriptions of the operations of minds. Surely the actual occurrence of beliefs in logically incompatible propositions makes nonsense of the claim that the principle of noncontradiction expresses a universal fact of psychology (p. 66).

Regarding the work of Boole referred to above (*An Investigation of the Laws of Thought*), Cohen and Nagel (1934) comment: "The title is a misnomer"

[1] This paper was written when the author was a Fellow of the John Simon Guggenheim Memorial Foundation.

(p. 112). A more extreme statement of this point of view is by Bertrand Russell (1904):

> Throughout logic and mathematics, the existence of the human or any other mind is totally irrelevant; mental processes are studied by means of logic, but the subject-matter of logic does not presuppose mental processes, and would be equally true if there were no mental processes (p. 812).

Schiller (1930), too, holds that syllogistic reasoning "has nothing whatever to do with actual reasoning, and can make nothing of it" (p. 282). He describes the "Laws of Thought" (laws of identity, contradiction, and excluded middle) as "verbal conventions" (p. 251).

The changed point of view with regard to the relation between logical principles and the laws of thought seems to be a function of an altered intellectual climate rather than of any fundamental discoveries about the nature of reasoning. It thus seems worthwhile to reopen the question, the more so since it has implications for a number of central issues in the psychology of thinking. First, however, it may be of interest to examine a few more forms in which the present question has been raised.

Discussion of the figures of the syllogism has at times centered on their relevance to actual thinking. J. N. Keynes (1887) cites several writers who reject the fourth figure because they hold that we do not actually reason in it (pp. 230–231). Kant (1885), indeed, finds all but the first figure both useless and false; the fourth in particular he calls unnatural (pp. 84–90). Keynes, on the other hand, argues for the admission of Figure 4 on the same grounds, namely its relevance to actual thinking: "It is not actually in frequent use, but reasonings may sometimes not unnaturally fall into it" (p. 232).

Psychologists investigating reasoning processes have tended to underemphasize the role of logic in the thinking of their subjects. To illustrate, Bruner, Goodnow, and Austin (1956) suggest that

> much of human reasoning is supported by a kind of thematic process rather than by an abstract logic. The principal feature of this thematic process is its pragmatic rather than its logical structure (p. 104).

Individuals tend to prefer "empirically reasonable propositions" to logical ones (p. 104). Morgan and Morton (1944) conclude that:

> A person is likely to accept a conclusion which expresses his convictions with little regard for the correctness or incorrectness of the inferences involved. Our evidence will indicate that the only circumstance under which we can be relatively sure that the inferences of a person will be logical is when they lead to a conclusion which he has already accepted (p. 39).

Lefford (1946) states that the principles of logical inference "are techniques which are not the common property of the unsophisticated subject" (p. 144). He goes so far as to distinguish from the logical inference

> psychological inferences which may be made by the ordinary person. . . . A psychological inference is not valid or invalid except when judged as a logical inference: psychological inference is purely a fact (p. 145).

Common to all these statements by the psychologists is the assumption that logical principles are irrelevant, if not antithetical, to much actual reasoning.[2] This conclusion is derived from the

[2] A different, but related, position is that represented by Dollard and Miller (1950), who hold that being logical is a learned drive. The child, it is argued, is punished for logical contradictions and absurdities, for illogical and contradictory plans. The result for most people is "a learned drive to make their explanations and plans seem logical" (p. 120). The implication is, of course, that without this specific training the individual's thinking would not be (or seem) logical.

high incidence of wrong inferences of subjects under test conditions, especially in the case of emotionally relevant material. A different conclusion has been drawn by Von Domarus (1944) from observation of errors in the reasoning of schizophrenic patients. This author argues, not that the reasoning of his subjects is unrelated to logic, but rather that it conforms to a logic whose laws are different from those of Aristotelian logic. This is "paralogic," which excludes the law of contradiction and "accepts identity based upon identical predicates" (p. 111). This idea has been elaborated by Arieti (1955) who sees the operation of this logic (which he calls paleologic) not only in schizophrenic and primitive thinking, as Von Domarus does, but also in dreams, in some infantile thinking, and in the transference situation in psychoanalysis.

Again it is of interest to find that the earlier writers mentioned above were equally aware of the problem of error, but viewed it in a way that was entirely compatible with their conception of logic as the science of the laws of the mind. "It is easy to see how truth is possible," writes Kant (1885, p. 44) "since in it the understanding acts according to its own essential laws." Error, however, is difficult to understand since it constitutes "a form of thought inconsistent with the understanding." Its source is thus not to be sought in the understanding itself, but rather in the "unobserved influence of the sensibility on the understanding," the sensibility being that faculty which "supplies the material for thought." Boole (1854) likewise considers that "the phaenomena of incorrect reasoning or error . . . are due to the interference of other laws with those laws of which *right* reasoning is the product" (p. 409). He reminds us that "the laws of correct inference may be violated, but they do not the less truly *exist* on this account" (p. 408). Mill (1874) is still more explicit. Discussing fallacies of ratiocination, he points out that since

> the premises are seldom formally set out, . . . it is almost always to a certain degree optional in what manner the suppressed link shall be filled up. . . . [A person] has it almost always in his power to make his syllogism good by introducing a false premise; and hence it is scarcely ever possible decidedly to affirm that any argument involves a bad syllogism (p. 560).

In the case of arguments consisting not of a single syllogism but of a chain of syllogisms, he considers the commonest fallacy of ratiocination to lie in a changing of the premises as the argument proceeds.

Two clearly contrasting alternatives thus present themselves: Is logic (or Aristotelian logic) largely irrelevant to the thinking process, or is it concerned with the laws of thinking? Since we will here be concerned only with deductive reasoning, we may reformulate the question more specifically in these terms. But since, as has so often been pointed out, the premises from which we reason are commonly not spelled out, since our inferences so frequently appear as enthymemes,[3] this fact must be taken into consideration. We may ask: If we know the premises—tacit as well as explicit—from which a person reasons, can we put the process in syllogistic form? Do the rules of the syllogism describe processes that the mind follows in deductive reasoning, even when the syllogistic form is not explicitly employed?

It has been shown above that the existence of error has been used as evidence for the irrelevance of logic to the actual thinking process. On the other hand, a different interpretation of error

[3] "A syllogism that is incompletely stated, in which one of the premises or the conclusion is tacitly present but not expressed, is called an enthymeme" (Cohen & Nagel, 1934, p. 78).

has been suggested. Since the problem of error seems to be a particularly fruitful one in which to join the issues before us, it will be taken as the context for the present discussion. Once more we may reformulate our question as follows: Do errors in deductive reasoning mean that the logical process has been violated? As Mill expresses it, does the occurrence of error mean that the syllogism is a bad one? Or can the error be accounted for otherwise? Is it possible that a process that would follow the rules of logic if it were spelled out is discernible even when the reasoning results in error?

The distinction being made here is a familiar one in the psychology of learning and thinking. Thus Koffka (1935, Ch. 12) distinguishes between learning as accomplishment and the learning processes responsible for this accomplishment. Köhler's (1927) distinction between "good errors" and stupid ones is likewise relevant. Good errors, he points out, "may, in a certain sense, be absolutely appropriate to the situation" (p. 217), although they solve the problem no more than do stupid ones. Wertheimer (1959), too, distinguishes between solutions obtained by "blind" procedures and "fine, genuine solutions." Again the difference is one of process, since in both cases the result may be the same. In the same way, in connection with the present problem, we may ask: Given contrasting results—correct solutions and errors in deductive reasoning—what can we say about the thinking processes that account for them? Are the processes necessarily different because their effects are different?

Illustrative data that bear on this issue will be presented. They were obtained from 46 graduate students of psychology who were asked to evaluate the logical adequacy of deductions presented in the context of everyday problems. Most of the subjects had no training in formal logic.[4] The material was presented under group conditions, the subjects writing out their judgments and their grounds for making them. Instructions included an explicit statement that the logical adequacy of the arguments was to be judged, not the truth of the statements.

Individual interviews were also conducted with a different set of subjects. Although the results agree generally with those obtained under group conditions, they will not be presented because of a problem already mentioned. Mill, it has been seen, pointed to the difficulty of recognizing a bad syllogism because a person can easily introduce into his incompletely stated argument a new premise that will make the inference valid. It was often difficult to decide whether the material elicited by direct questioning consisted of new premises not entering into the original inference, or whether the subject was, as intended, making clear his original understanding of the premises. Although the group data are less rich than the individual interviews, and although the products of written communication are likely to be less spontaneous reflections of the thinking process than interviews, they exclude this possibility of overlooking true fallacies; indeed, if anything, they overestimate the incidence of bad syllogisms, since the reasoning is often incompletely described in the case of apparent errors.[5]

The present data will be used only to illustrate the reasoning processes in cases of error; no quantitative results

[4] It must be recognized, of course, that the lack of formal training in logic is insufficient guarantee of the naiveté of subjects. It can only be pleaded that we have no better criterion at the present time. Whatever the informal self-education of subjects in this respect, the results to be presented cannot be regarded as the product of formal instruction in logic.

[5] A sample interview may be found in Henle (1958).

will be presented. As many authors have shown, the incidence of error in deductive reasoning depends on the form of the syllogism and its contents, as well as on instructions to the subjects. Quantitative results would have relevance only to the particular conditions studied here, whereas an inquiry into the nature of the errors obtained might be of more general interest.

Several processes may be distinguished which led to error in dealing with the presented material:

FAILURE TO ACCEPT THE LOGICAL TASK

More specifically, this means failure to distinguish between a conclusion that is logically valid and one that is factually correct or one with which the subject agrees. This source of error has already been reported by Henle and Michael (1956, p. 124).

A sample syllogism follows, along with responses in which errors occur because of failure to grasp or accept the logical task.

Syllogism 6. A group of women were discussing their household problems. Mrs. Shivers broke the ice by saying: "I'm so glad we're talking about these problems. It's so important to talk about things that are in our minds. We spend so much of our time in the kitchen that of course household problems are in our minds. So it is important to talk about them." (Does it follow that it is important to talk about them? Give your reasoning.)

Responses: "The conclusion does not follow. The women must talk about household problems because it is important to talk about their problems, not because the problem is in their minds."

"No. It is not important to talk about things that are in our minds unless they worry us, which is not the case."

"No. Just because one spends 'so much time' in the kitchen it does not necessarily follow that household problems are 'in our minds'."

It should be noted that subjects who failed to accept the logical task frequently gave correct responses that are just as irrelevant to the question of the relation of logic to the thinking process as are the errors just cited. A few examples follow:

"Yes. It could be very important to the individual doing the talking and possibly to some of those listening, because it is important for people to 'get a load off their chest,' but not for any other reason, unless in the process one or the other learns something new and of value."

"Yes. It seems obvious that problems which are in the forefront of one's mind bring more consideration to them and possibly newer aspects when they are discussed with another. Two heads may be better than one."

"Yes it does. By talking household problems, a problem can be solved or worked through."

The errors illustrated here clearly do not demonstrate an inability of the subjects to reason logically, since they have not accepted the logical task. They have evaluated the content of the conclusion, not the logical form of the argument. Richter (1957, p. 341) makes the same distinction, carrying the analysis a step farther. Apart from careless mistakes and those arising from "imperfections in the classifying operation"—i.e., from an inability to make logical deductions, he describes errors arising from "a general failure to grasp the concept of 'logical validity'" and those arising from "the specific inability to differentiate 'logical validity' from another attribute of syllogisms," namely their factual status. To apply to the present data, the factual criterion needs to be interpreted to