COGNITIVE PSYCHOLOGY 1, 134–148 (1970)

A Theoretical Analysis of Insight Into a Reasoning Task[1]

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An information-processing analysis of insight into a singularly deceptive and difficult deductive problem is presented. Two models are described. The first represents an economical explanation of the *S*s initial responses but is difficult to reconcile with their subsequent responses induced by certain remedial procedures. The second model does take account of such responses and shows how insight into the correct solution is correlated with the awareness that tests for falsification are more appropriate than tests for verification. The relevance of the experimental results and the explanatory model are discussed in relation to wider issues.

Previous research on deductive reasoning has usually involved the evaluation of given inferences as valid or invalid, or the making of inferences from given premises. These techniques have been a characteristic feature in studies of syllogistic reasoning, in studies of the effect of personality variables upon the deductive process, and in miscellaneous investigations of logical competence. Such research has increased our knowledge about the interactions between cognitive and affective processes and about the layman's general logical ability, but it has perhaps been less revealing about the process of reasoning itself. A notable exception is, of course, provided by research on the computer simulation of thinking (e.g., Newell, Simon, & Shaw, 1958; Reitman, 1965.) In the tasks which we shall consider the *S*s have neither to make inferences in a direct fashion from premises presented to them, nor to evaluate given conclusions as valid or invalid. They have to choose the conditions which would allow a valid inference to be made. These tasks are structurally simple but deceptively difficult, and the present paper offers a theoretical analysis of the attempts to solve them.

THE PROBLEM

This is one example of the problem (Wason, 1966). You are presented with four cards showing, respectively, "A," "D," "4," "7," and you know

[1] Grateful acknowledgements are due to Mrs. Diana Shapiro for technical help, and to the Medical Research Council for a grant for scientific assistance.

from previous experience that every card, of which these are a subset, has a letter on one side and a number on the other side. You are then given this rule about the four cards in front of you: *If a card has a vowel on one side, then it has an even number on the other side.*

Next you are told: "Your task is to say which of the cards you need to turn over in order to find out whether the rule is true or false."

The most frequent answers are "A and 4" and "only A." They are both wrong. The right answer is "A and 7" because if these two stimuli were to occur on the same card, then the rule would be false but otherwise it would be true. Very few highly intelligent *S*s get the answer right spontaneously; some take a considerable time to grasp it; a small minority even dispute its correctness, or at least remain puzzled by it. It would seem, however, that it is the *S*s' erroneous approach to the problem which causes the difficulty, rather than its structure. When the solution is given before presenting the problem, all the *S*s spontaneously gave the correct reasons for the solution (Wason, 1969a.)

The extreme difficulty of this task would seem to be of theoretical importance. In addition, the thought processes engaged in it are not as entirely removed from reality as they might seem: they are analogous to the crucial role which disconfirmation plays in hypothetico-deductive systems (e.g., Popper, 1959.)

NOTATION

The theoretical analysis is based on the combined results of four experiments. But before presenting their results, the notation used for referring to the problems will be described.

The rule, or test sentence, always had the same underlying logical form of a conditional sentence: "if p then q." In logic the variables p and q refer to atomic propositions. The convention will be adopted, however, that these variables refer, not to propositions, but to the stimuli designated by them. Hence, in the present example, p refers to a vowel, $\bar{p}$ (not-p) to a consonant, q to an even number, and $\bar{q}$ (not-q) to an odd number.

The selection of the cards will be referred to by citing the appropriate letters, e.g., "p and q," "p, q, and $\bar{q}$." Since the constraint is always imposed that there is a value of p (or $\bar{p}$) on one side of a card and a value of q (or $\bar{q}$) on the other side, the correct solution is the selection of p and $\bar{q}$.

When reference is made to a card, irrespective of the value on its other side, the appropriate letter will simply be cited. When the values on both sides are relevant, but the S has not seen the value which is face downwards, the latter value is mentioned second and placed in parentheses, e.g., q (p). When both sides of a card have been seen, the parentheses will be omitted and the value which was originally face upwards cited first.

EXPERIMENTAL RESULTS

Table 1 shows the frequency with which cards were initially selected in four experiments in which all the *S*s were university students (Wason, 1968; Wason, 1969b; Wason & Johnson-Laird, in press).

It will be noted that two errors frequently occur: the selections are not random. $\bar{q}$ is omitted and q is selected, but the former error is much more pervasive. The 13 errors classified under "others" consisted in 10 cases of the inclusion of $\bar{p}$, or the omission of p, and in three cases of the selection of all four cards. The latter selection was difficult to interpret. It is the correct response if the rule is construed as equivalence, i.e., "if, and only if, p then q." But there was considerable introspective evidence that the *S*s were selecting all four cards in order to avoid any possible error of omission. Indeed, when the *S*s claimed to be construing the rule as an equivalence (e.g., "I assume the converse holds"), they nearly always selected just p and q.

In the pilot study (Wason, 1966) the task was binary in the sense that values of both p and q were dichotomized: a letter which is not a vowel is a consonant, and a whole number which is not even is odd. But the actual stimuli on the cards were not binary; they were letters and numbers falling under these classes. The initial selections, however, were similar under all the following experimental modifications.

1. The task was strictly binary. The *S*s knew that only two possible stimuli could occur on the other side of each card, e.g., a red triangle had only a red or a blue circle on the other side (Wason, 1969b.) It was argued by others that under this tightly controlled situation error would be significantly reduced.

2. In another condition, $\bar{p}$ could be satisfied by any geometric figure other than a square and $\bar{q}$ by any colored scribble other than a red one (Wason, 1968.) It was argued by others that $\bar{q}$ would be more likely to be

TABLE 1
Frequency of Initial Selection of Cards in Four Experiments

p and q	59
p	42
p, q, and $\bar{q}$	9
p and $\bar{q}$	5
Others	13
	$N = 128$

recognized as such, and hence selected, when it could not be named *a priori*.

3. All the information was potentially visible on the same side of the cards but partially masked (Wason & Johnson-Laird, in press). It was argued by others that *S*s tended to interpret the "other side" of a card as being the side which is face downwards.

4. The values of $\bar{p}$ and $\bar{q}$ consisted in the absence of any stimulus at all (Wason & Johnson-Laird, in press). It was argued by us that $\bar{q}$ would be appreciated as such more readily if it were to consist in the absence of q rather than being satisfied by some stimulus other than q.

5. The rule was expressed as a quantified sentence rather than a strict conditional, e.g., "every card which has a red triangle on one side has a blue circle on the other side" (Wason, 1969b). It was argued (H. H. Clark, personal communication) that a sentence in the form, "if p then q," has the undesirable connotation of a temporal, or even causal, relation between p and q.

6. Detailed instruction was given that the converse of the rule could not be assumed (Wason, 1968.)

An Algorithm for Testing the Rule

Before presenting the model of human performance it will be useful to consider one simple way that a computer might be programmed to solve the problem. The algorithm provides a base line that contrasts sharply with human performance.

The first step for the computer would be to retrieve the truth table appropriate to the rule, in the present case, "if p then q." In the propositional calculus a rule in this form is known as material implication. It is true under the following combinations of values: (p and q), ($\bar{p}$ and q), and ($\bar{p}$ and $\bar{q}$), and false in only one instance (p and $\bar{q}$). However, it is unreasonable to assume that *S*s construe a conditional as true when its antecedent is false. And it has been demonstrated (Johnson-Laird & Tagart, 1969) that most *S*s (79%) evaluate ($\bar{p}$ and q) and ($\bar{p}$ and $\bar{q}$) as irrelevant to the truth or falsity of the rule. In fact, only 4% construed the rule as material implication. But in the present context, the important point is that both the truth table for material implication and the "defective" truth table in which the two $\bar{p}$ cases are irrelevant rather than true, and which most *S*s evidently use, give identical results in relation to the values which have to be selected in order to determine the truth of the rule.

Having retrieved either truth table the computer would scan each card in turn with reference to all four combinations in the truth table. Its algorithm is then governed by the following simple principle: a card is selected as potentially informative if, and only if, a value on it can make the rule false when it is associated with another value. Thus p would be selected because it would falsify the rule if it were associated with $\bar{q}$; and for the same reason $\bar{q}$ would be selected. But neither q nor $\bar{p}$ can falsify under any circumstances, and hence they would not be selected.

It is quite evident from the experimental results not only that human *S*s fail to perform in accordance with this algorithm, but that they do not even perform in accordance with their own truth table for the rule. The source of error in the problem would seem to be connected with the failure to appreciate the crucial importance of falsification as opposed to verification.

The Preliminary Model

A preliminary information-processing model has been devised to account for the initial selections in the task (see Fig. 1). It is an economical model which is not specific to conditional rules but applies to any logical connective for which a truth table can be specified. It will be noted that the model postulates two kinds of insight: insight (a) and insight (b). (In explaining the model, the numbers in parentheses refer to the different elements in the flow diagram and enable the reader to keep track of the behavior of a hypothetical *S*.)

The *S* first examines the rule and implicitly selects the appropriate truth table (0). If he has neither kind of insight, he examines each card in turn (1, 2, 3), asking himself whether there is any value on the other side which could verify the rule (4). If there is, he will select that card (6, 9); if there is not, he will reject it as "irrelevant" (5, 11). Hence, with a conditional rule he will select just p and q.

If the *S* possesses insight (a), but not insight (b), he will test those cards which could verify to see whether, in addition, they could falsify the rule. Hence, $\bar{p}$ and $\bar{q}$ will still be rejected because they could not verify, but q will also be rejected because, although it could verify, it could not falsify the rule (4, 6, 7, 11). The *S* will accordingly select just p.

If the *S* possesses insight (b), but not insight (a), he will test those cards which could not verify to see whether they could falsify the rule. Hence he will select p and q because they could verify; he will reject $\bar{p}$ because it could neither verify nor falsify (4, 5, 7, 11); but he will select $\bar{q}$ because, although it could not verify, it could falsify (4, 5, 7, 8, 9).

If the *S* possesses both kinds of insight, he will test all cards, regardless of whether they could verify, to see whether they could falsify the rule. Hence, he will select the correct cards: p (4, 6, 7, 8, 9) and $\bar{q}$ (4, 5, 7, 8, 9).

If will be noted that when a card could falsify the rule, it will also be

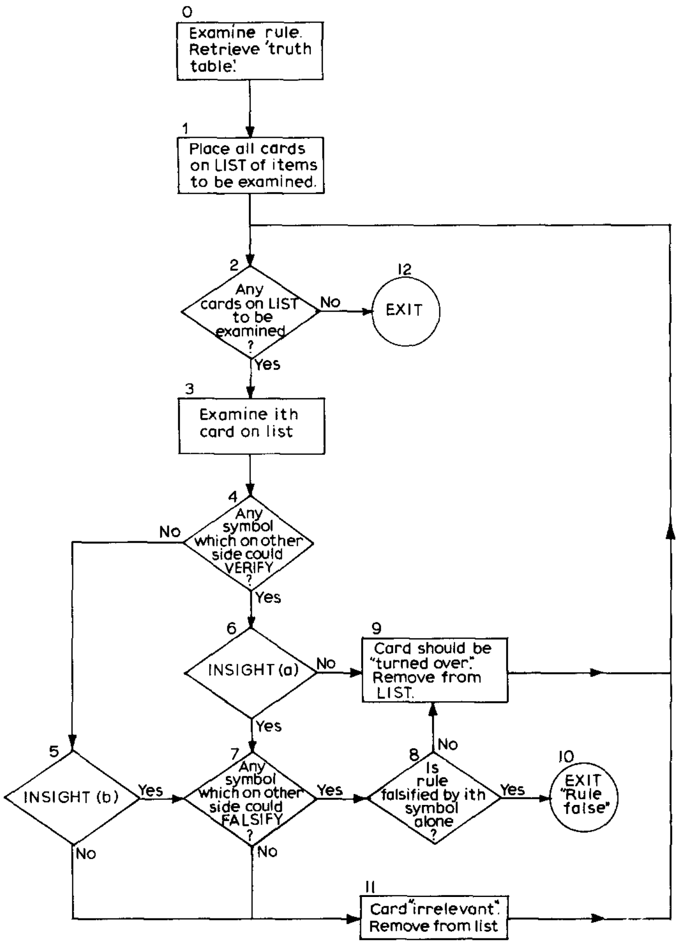

FIG. 1. The preliminary model.

tested to see whether its value already falsifies the rule (8). This routine is pertinent only to rules such as "neither p nor q," and "p and q," where p immediately falsifies the first rule, and $\bar{p}$ immediately falsifies the second rule.

This model does some justice to the data so far presented, and it is consistent with the relative stability of the initial selections. But there are two grounds which cast doubt upon its adequacy to reflect the psychological processes which seem to guide performance.

First it seems implausible to suppose that insight (a) occurs about three times as often as insight (b). Insight (a) involves the rejection of a value because it could not falsify, and insight (b) involves the acceptance of a value because it could falsify. *A priori,* it would not seem that (a) should be so readily attained in comparison with (b); and indeed, the suspicion arises that insight (a), as it functions within the model, is wrong. The initial selection of only p may not indicate a deep insight but merely signify that the S construes the rule as asymmetric—he will frequently say, "I did not assume the converse to hold," and sometimes ask E whether it does hold.

Second, our suspicions are increased by the consequences of certain remedial procedures which were introduced after the Ss had made their initial selection. These will be discussed more fully in the next section, but it is relevant here to say that an S who had initially selected just p frequently changed his choice to p, q, and $\bar{q}$, as a consequence of these procedures. To account for this transition on the current model one would have to postulate the gain of insight (b) simultaneously with the loss of insight (a). Insight (b) is necessary for the selection of $\bar{q}$, and insight (a) is necessary for the nonselection of q. Moreover, the transition from p and q to just p, which would correspond to the gain of insight (a) alone, hardly ever occurred.

These considerations suggest that the selection of only p is labile, that it is not so much a true insight as a consequence of the way the rule is interpreted, and that hence the preliminary model is erroneous. Before elaborating a revised model, which corrects these features, the remedial procedures will be discussed.

Remedial Procedures

Simply asking the Ss to think again about their selections or getting them to imagine falsifying values on the back of the cards (Wason, 1968) does not make the Ss change their selections. Similarly, treating the problem as a learning task (Hughes, 1966) is unenlightening. A drastic simplification in the structure of the task, i.e., a choice between only values of q and $\bar{q}$, does however enable all the Ss to gain insight eventually (Johnson-Laird & Wason, 1970).

When the material consists of all four values the introduction of certain remedial procedures by E, after the Ss had made their initial selections, does also enable the majority to achieve the correct solution eventually. The rationale of these procedures was to create a conflict, or contradiction, between the Ss initial *selection* of cards and a subsequent *evaluation* of the cards with respect to the truth or falsity of the rule. Such evaluations were either hypothetical when the S considered the effect of a possible value on the other side of a card, or actual when he saw the values on both sides of a card.

These procedures were effective in two experiments (Wason, 1969b; Wason & Johnson-Laird, in press). There appeared to be four qualitatively distinct stages with respect to the interaction between the selection and evaluation processes. They may seem incredible to anyone who has not experienced them directly.

1. In the first stage it is assumed that the *S* merely evaluates the cards by reference to what was, or was not, initially selected. In this way the selection process totally dominates the evaluation process. For example, suppose p were initially selected and $\bar{q}$ not selected, then p ($\bar{q}$) would be evaluated as falsifying, but $\bar{q}$ (p) denied such a status. Similarly, if q were selected and $\bar{p}$ not selected, then q ($\bar{p}$) would be evaluated as falsifying, but $\bar{p}(q)$ dismissed as irrelevant. These bizarre phenomena occurred quite frequently in the earlier experiments but less frequently in the later ones; they clearly suggest that the reversibility of the cards is not always recognized.

2. In the second stage it is assumed that the *S* does appreciate the reversibility of the cards. Hence he is consistent in his evaluations, regardless of which cards had been selected and which side had been face upwards. But surprisingly this does not necessarily lead to any gain of insight. The $\bar{q}$ (p) card may be evaluated as falsifying, but $\bar{q}$ may not be selected after this correct evaluation, even when both sides of the card have been exposed. Similarly, the q ($\bar{p}$) card may be evaluated correctly as irrelevant, but q may still be selected. Responses of this kind pervaded the protocols of the *S*s and were the most characteristic feature of performance in the tasks. Clearly, the insight that a card should be selected if it falsifies, or rejected if it is irrelevant, does not follow merely from the correct evaluation of the cards.

3. In the third stage it is assumed that the *S* appreciates, for the first time, the crucial importance of cards which could falsify the rule; and that this comes about from a consideration of the effects of two cards; p (q) and $\bar{q}$ (p). The former indicates that the rule is true; the latter indicates that it is false. Quite a large proportion of the *S*s are unable to resolve this conflict, even when both sides of the cards are revealed, and dismiss $\bar{q}$ p with rationalizing remarks. Others do gain the necessary insight and accordingly select $\bar{q}$.

4. In the final stage it is assumed that the *S* appreciates that only cards which could falsify should be selected, and this would seem to involve the evaluation of the rule with reference to q (p) and $\bar{p}$ (q). The former verifies; the latter is irrelevant. It seems likely that two factors make this insight particularly difficult. First, a conflict between a card which verifies and one which is merely irrelevant is unlikely to be so intense as a conflict

between a card which verifies and one which falsifies. Second, q is likely to have been selected at some point, and hence the S may be reluctant to reconsider it.

These processes could be incorporated into an information-processing model of how an individual changes from one level of insight to another. Such a step, however, would be premature for several reasons. There is much greater variance in the Ss' response to remedial procedures than in their initial selections. Some Ss are able to gain complete insight as the result of a single remedial exercise; a few never gain insight and dispute the correctness of the solution. Similarly, the apparent failure to appreciate the reversibility of the cards may be, to some extent, a function of the abstract stimulus material. Cyril Burt (personal communication) has pointed out that when the problem is presented in the guise of a story, the majority of intelligent children tested in one study were able to solve the problem. This result has been replicated by us with a student population (Wason & Shapiro, unpublished). The rule was, "Every time I go to Manchester I travel by train," where p and $\bar{p}$ stood for two different towns, Manchester and Leeds, and q and $\bar{q}$ for train and car. More than half the Ss saw the correct solution almost instantaneously.

Our original investigations were designed to induce insight into the problem rather than to study the complex and unpredicted phenomena arising from the procedures devised to induce it. But any model of the selection process cannot neglect the results of these procedures. In particular, it must account for the "paradoxical" gain of insight (b) and loss of insight (a): the transition from selecting p to selecting p, q and $\bar{q}$.

The Revised Model

Figure 2 shows the flow diagram of the revised model of the selection process, which attempts to take account of the initial selection of the cards, the order in which they are selected, and changes in selection due to remedial procedures. It is thus a model which allows both for differences between Ss and for changes within an individual S's performance.

There are two main differences between the preliminary and revised models. First, the revised model assumes that the S without insight will focus on cards mentioned in the rule. If he assumes that the rule implies its converse, then both p and q will be selected. If the converse is not assumed, then only p will be selected. This provides a more plausible reason of why so many Ss chose only p initially, and it is more consistent with their introspective reports.

Second, two levels of insight have been retained, but their qualitative

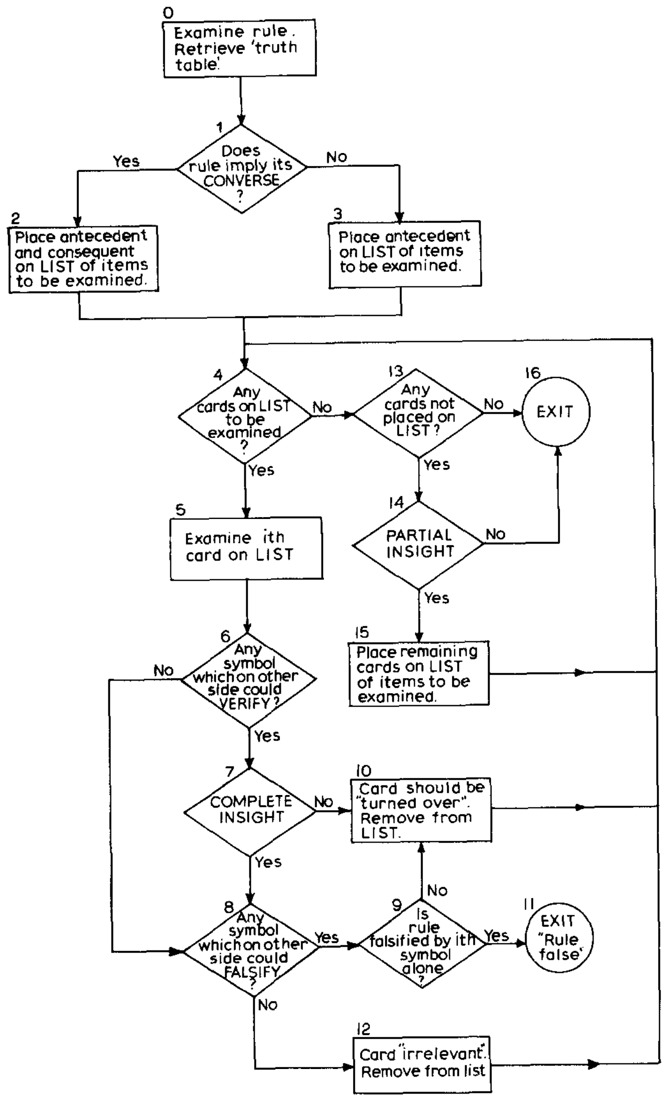

FIG. 2. The revised model.

nature and their location in the flow diagram have been changed. They are no longer independent. "Partial insight" consists in realizing that cards which could falsify should be selected. "Complete insight" consists in realizing that only cards which could falsify should be selected. (It will be noted that this insight corresponds to the central principle of the algorithm considered earlier.) Hence complete insight entails partial insight: the former cannot be gained without gaining the latter. There is empirical support for this modification. Many *S*s maintain a final selection of *p*, *q*, and $\bar{q}$ (partial insight), but hardly any maintain a final selection of only *p* [corresponding to insight (a) in the preliminary model].

All *S*s will begin by placing either *p* and *q* (0, 1, 2) or only *p* (0, 1, 3) on their list of items to be tested. There are then three possible levels of insight.

No insight. *S*s without any insight will select only these values because they alone could verify the rule (4, 5, 6, 7, 10). They will test no further cards (4, 13, 14, 16).

Partial insight. *S*s with partial insight will go on to place the remaining cards on the list of items to be tested (4, 13, 14, 15). Regardless of the initial selection, $\bar{p}$ will be considered irrelevant because it could neither verify nor falsify (4, 5, 6, 8, 12), and $\bar{q}$ will be selected because it could falsify (4, 5, 6, 7, 8, 9, 10). An *S*, who did not initially place *q* on the list, will do so now and select it because it could verify. Thus an *S* with partial insight will ultimately select *p*, *q* and $\bar{q}$.

Complete insight. *S*s with complete insight will select *p* and $\bar{q}$ and reject *q* because it could not falsify (4, 5, 6, 7, 8, 12). Since the question of complete insight arises when *S* encounters a card which could verify the rule, it can occur in two main ways. It may be gained during the initial tests. But if *S* initially rejected the converse, it may be gained after partial insight when *S* is testing *q* for the very first time. However, an *S* who initially accepts the converse and selects both *p* and *q* should be much less likely to gain complete insight after gaining partial insight. He would have no occasion to retest *q* and hence could not take the appropriate path in the flow diagram (from 6 to 7).

There is some empirical support for this aspect of the model. Many more of the *S*s who initially selected only *p* gain complete insight than do *S*s who initially selected both *p* and *q*. It is also particularly rare for the latter group of *S*s to pass from partial insight to complete insight.

The Conceptual Status of the Revised Model

The model provides a precise statement, in information-processing terms, of the extremely complex behavior exhibited by highly intelligent *S*s performing the selection task. Such an analysis brings out clearly the differences in the way in which a machine and a human being attempt to solve the problem. But what sort of evidence would refute the model and show it to be inadequate as an explanation of performance? There are several possibilities.

It will be noted that the greater the insight of an *S*, the greater the number of routines in the model through which he passes. Hence it is possible to derive predictions about reaction times. One might consider an experiment in which a decision has to be reached about the cards presented individually. The model would predict that, when p is presented, all the *S*s would select it, and the reaction time would be relatively rapid. But the selection of $\bar{q}$, which depends upon an additional falsification routine, should take a relatively longer time. Such an experiment would obviously allow a more sensitive degree of measurement than the merely nominal classification used in the experiments under consideration.

Second, other logical connectives could be used to test the model. For instance, with the disjunctive rule, "p or q," the correct selection is $\bar{p}$ and $\bar{q}$. But partial insight would lead to the selection of all four cards—a result which hardly ever occurs with a conditional rule. Hence, if a considerable number of *S*s went through the following stages: (1) p and q, (2) p, $\bar{p}$, q, and $\bar{q}$, (3) $\bar{p}$ and $\bar{q}$, then the validity of the model would be corroborated. If other responses, or sequences of responses occurred, then doubt would be cast on its general validity. Some promising results have been obtained (Wason & Johnson-Laird, 1969), but unfortunately *S*s were constrained by having to select a limited number of cards in this experiment.

An experiment by Legrenzi (1970) is also relevant. The rule was, "it is not possible for there to be a vowel on one side of a card and an odd number on the other side." In an independent evaluation study Legrenzi found that only the contingency "A and 3" was considered to falsify the rule. Hence, on the assumption that the rule is construed as symmetric, the model generates the following predictions. An *S* without insight will make the correct selection, "A and 3," since both A and 3 could verify the rule. However, an *S* with partial insight will consider all four cards, i.e., A, B, 2, and 3, and since each could verify, he will select them all. Finally, an *S* with complete insight will also make the correct selection since only "A and 3" could falsify the rule. In fact, Legrenzi found that 77% of the *S*s made the correct selection, and 17% selected all four cards. Moreover, he had the impression that many of the *S*s who made the correct selection had little insight into the task.

Related Issues

Even if the model were to be rejected, the results of the experiments cannot be denied. They strongly suggest that Piaget's theory of "formal operations" in intelligence is deficient. If Piaget were right (Inhelder & Piaget, 1958), the *S*s in our experiments would have reached the stage of formal operations. Such individuals would take account of the possible and the hypothetical by formulating propositions about them. They would be able to isolate the variables in a problem and subject them to a combinatorial analysis. More specifically, Piaget (Beth & Piaget, 1966, p. 181) claims that the adolescent, confronted by a complex causal situation, will ask himself whether fact *x* implies fact *y*, and frequently do this by formulating a proposition in the form, "if *p* then *q*." In order to test this proposition he will search for the counterexample, *x* and non-*y*, i.e., *p* and $\bar{q}$. It is, of course, just this which our highly intelligent *S*s conspicuously fail to do. Hence, either formal operations are specific to familiar or causal tasks, and not cognitive abilities which can be applied to any problem whatsoever, or there is something about the present problem which may induce the *S*s to regress temporarily to earlier modes of cognitive functioning. There is some *prima facie* evidence for such regression (see especially Wason, 1969b). The remedial procedures revealed several cases of the failure to appreciate "reversibility," and the operation of reversibility is of central importance in Piaget's theorizing and a distinguishing feature of "preoperational thought." It is, of course, admitted by Piaget (Tanner & Inhelder, 1960, p. 126) that the adult does not engage in formal operational thought all the time, but it is apparently assumed that such operations would be exercised when he is confronted by a challenging deductive problem. Our tasks, although novel, are challenging and preeminently appropriate for combinatorial analysis.

The results are also relevant in a quite different area. Whatever the origin of prejudice, it is plausible to suppose that certain prejudices are maintained in the face of contrary evidence because the prejudiced individual lacks a type of insight which is analogous to the insight required to solve our problem. A person who believes, say, that all actors are effeminate, is unlikely to test his belief by scrutinizing actors because there is no immediate way of identifying them. Nor will such a person consider people who are not effeminate as relevant to his belief. What is more likely is that he will note the occupation of any effeminate individual he may encounter. If such an individual turns out to be an actor, the belief is confirmed. If he turns out not to be an actor, the belief is obviously (and quite validly) unaffected. In this way the prejudice is proof against falsification.

A final feature of the present experiments is the wide range of individual differences which were revealed. Such differences are unlikely to be related to conventional measures of intelligence since the range of these measures in a student population is likely to be very small. The most interesting aspect of these differences was the number of *S*s who were extremely resistant to the influence of the remedial procedures. It is a plausible hypothesis that this factor is related to personality differences and, perhaps, to a tendency to structure a problem situation impulsively.

CONCLUSIONS

The selection task, using a conditional rule, is an extremely difficult problem although, unlike the classic Gestalt problems, the *S*s initially experience no sense of difficulty. They are nearly always content to verify the rule by attending to the values explicitly mentioned in it. It is as if the values unmentioned in the rule play no part in the problem, a supposition very frequently corroborated by introspective reports. This results in error and may well lead to striking inconsistencies between previous selection and current evaluation of the material—inconsistencies which may, or may not, be recognized, tolerated, and resolved. When they are not recognized or resolved, an individual *S* begins to sound almost as if he were really two different people talking.

Gain of insight seems to depend upon three factors. First, the *S* must appreciate that the cards are reversible. He then has information which, in principle, can provide an escape from the effects of his own initial selection and enable him to evaluate the cards correctly. Second, he must be able to resolve the apparent conflict between his correct evaluation of p (q) and $\bar{q}$ (p). This leads to the partial insight that cards which could falsify should be selected. Finally, he must resolve the conflict between his correct evaluations of q (p) and $\bar{p}$ (q) in order to gain the complete insight that only cards which could falsify should be selected.

This analysis of the development of insight is considerably more tentative than that of the information-processing model itself. While it may be necessary to modify the detail of this model, its general explanatory principle, involving the distinction between verification and falsification, seems to provide a satisfactory account of performance.

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(Accepted February 17, 1970)