THE CURIOUS EFFECT OF USING DRAWINGS IN CONDITIONAL REASONING PROBLEMS

ABSTRACT. College level students were given two paper and pencil conditional reasoning tests in varying order. The first test consisted of three problems presented entirely verbally. The second test was identical to the first except that two of the three problems made use of line drawings as concrete referents. Performance on the problems with drawings was significantly worse than for purely verbal presentation. In addition, interaction effects between the two forms of presentation were observed over the one-week interval between the two tests.

Conditional reasoning is one of the more important manifestations of formal thought. Being able to draw conclusions on the basis of a hypothesized “if $P$ then $Q$” relation is vital in many different contexts and certainly represents one of the basic skills of complex thought. Four specific inferences are frequently used to define conditional reasoning of this type: modus ponens ($P$ is true), converse ($Q$ is true), inverse ($P$ is false) and contraposition ($Q$ is false). Experimental results have generally shown that even educated adults have great difficulties in dealing with the full range of these deductions (Bree and Copens, 1976; Karplus and Karplus, 1970; O’Brien, 1973, Staudenmeyer and Bourne, 1977; Sternberg, 1979; Wason, 1968; Wildman and Fletcher, 1977). Although modus ponens and the contraposition are almost always correctly resolved, these studies indicate that there is a tendency to respond to the converse and inverse as if the “if $P$ then $Q$” relation were a bi-conditional (referred to as a ‘transductive’ response; Knifong, 1974), or to give some other of a variety of intermediate responses (Markovits, 1984). In addition, it appears that performance on conditional reasoning problems may be affected by such variables as concreteness (Staudenmeyer, 1975) and linguistic factors (Roberge, 1982).

The purpose of this study was to investigate the effects of another variable, the use of referential (i.e., related, but not essential) drawings, on conditional reasoning performance. Such a variable has a particular pedagogical interest, as it mirrors a tendency to use images or concrete examples to illustrate complex principles. In fact, informal questioning of an admittedly small sample of educators revealed that all felt intuitively that providing the kind of concrete support used in this study should facilitate performance on conditional reasoning problems. On the other hand, some preliminary results appeared to indicate the contrary. It was thus decided to systematically study the effects of using simple line drawings as concrete referents in conditional reasoning problems.

Subjects: A total of 80 first year college students (average age: 18 years 5 months) were given two questionnaires at a one week interval. Of these, 43 received the drawings questionnaire followed by the verbal form and 37 received the two questionnaires in inverse order.

Material: Two paper and pencil questionnaires were constructed. The first, referred to as the verbal questionnaire, consisted of three conditional reasoning problems. Each problem started with the statement: “Suppose that it is true that”, followed by a conditional relation of the form “If P then Q”. After the initial statement, four multiple choice questions were asked, of the form “If you are told that P (or Q) is true (or false), then you can say that:”. For each of the four questions, subjects were given a choice of three responses: (a) Q (or P) is true, Q (or P) is false, (c) you don’t know whether Q (or P) is true or not. The three problems used the following conditional relations:

(a) “If a car is black, it is heavy.” (CAR)
(b) “If an object is a triangle, it is blue”. (OBJECT)
(c) “If there is a snow storm, school is closed.” (SNOW)

The second questionnaire, referred to as the drawings questionnaire was identical to the verbal form except that for the first two problems, CAR and OBJECT, a series of four line drawings appeared at the top of each page. For the CAR problem, two black cars and two white cars were portrayed, while for the OBJECT problem, there were two triangles and two circles (see Figure 1 for an example of the CAR drawings). Each of the drawings was identified by a letter (A to D). The initial statement used had the following form: “For each of the four cars (objects) A, B, C, D, suppose that it is true that:”. In the following four questions, drawings were referred to by letter wherever possible, i.e., instead of “if you are told that a car is black” the expression “if you chose car A” was used. The SNOW problem was entirely verbal for both questionnaires and served as a control problem.

Fig. 1. Drawings used in the CAR problem.