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The Effect of Selection Instructions on Reasoning about Thematic Content Rules in Wason's Card Selection Task

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Abstract

This study examined the effects of selection instruction and thematic content on subjects' reasoning performance on the Wason card selection task. Facilitation has frequently been demonstrated when subjects are instructed to check for violations of a conditional rule that involves thematic content. We noted that the thematic rules previously used are also pragmatic rules that express regulations. We compared reasoning about two kinds of thematic rules: pragmatic and non-pragmatic. Subjects were instructed either to determine if the rule has been violated or to determine if the rule is true or false. The results indicate an interaction between instruction type and thematic rule type. Contrary to previous findings of facilitation on thematic materials with violation instructions, we found facilitation for true/false instructions relative to violation instructions on non-pragmatic content rules. These results stand in contrast to previous descriptions of true/false instructions as more difficult and cognitively demanding than violation instructions. We explain our findings in terms of differences in the inherent status of the two types of thematic rules.

Introduction

This paper is concerned with subjects' performance on Wason's four-card selection task (Wason, 1966). In its original form, the selection task involved presentation of a pack of cards to subjects, each card having a letter on one side and a number on the other side. Subjects were presented four cards, showing E, K, 4, and 7, or the P, Not-P, Q, and Not-Q conditions, respectively. The subjects' task was to select which cards they would need to turn over in order to decide if the following rule was true or false: "If a card has a vowel on one side, then it has an even number on the other side."

Normatively, subjects should select the P and Not-Q cards because these are the only cards that can falsify the rule. That is, if Not-Q lies on the other side of the P card, or P lies on the other side of the Not-Q card, then one can be certain that the rule is false. However, the majority of subjects select either P alone or P and Q.

Since its inception, the task has been investigated with numerous procedural variations. Researchers have examined the effects of thematic versus abstract content, rule explication, selection instructions, and selection justification (Johnson-Laird, Legrenzi, & Legrenzi, 1972; Griggs & Cox, 1982; Hoch & Tschirgi, 1983; Yachanin, 1986). The current study concerns the effects of selection instructions and thematic content.

Wason and Shapiro (1971) reported better performance on a

conditional rule involving familiar content. Their subjects showed facilitation when reasoning about the rule, "Every time I go to Manchester, I travel by train." When reasoning about the thematic transport rule, sixty-two percent of subjects chose the correct P and Not-Q combination. Other thematic content rules for which facilitation was subsequently demonstrated include the postal rule (Johnson-Laird, Legrenzi, & Legrenzi, 1972), the drinking age rule (Griggs & Cox, 1982), and the Sears problem (D'Andrade, described by Griggs, 1983).

A number of explanations for superior performance on thematic content rules have been advanced (e.g., Cheng & Holyoak, 1985; Cosmides, 1989; Gigerenzer & Hug, 1992; Griggs & Cox, 1982). For example, Cheng and Holyoak (1985) explained performance on the drinking age, postal, and a number of original rules in terms of pragmatic reasoning schema theory. Pragmatic reasoning schemas concern regulations that involve permission or obligation. These schemas may be triggered by conditional rules that express a precondition and an action (Cheng & Holyoak, 1985). For example, a permission schema may be triggered by a conditional rule specifying that an action may be taken after an initial condition has been met, as is expressed in the rule, "If a person is drinking beer, then the person must be over 19 years of age." Cheng and Holyoak (1985) proposed that facilitation would be found as long as the rule triggered a permission or obligation schema that subsequently maps onto the rule.

Most accounts of facilitation with thematic materials underscore the importance of experience that is related to the rule's content. Of present interest, however, is the contention that the facilitation observed for thematic content rules may be driven in part by the instructions accompanying those rules. Wason (1966) initially presented the task to subjects with instructions to select those cards needed to determine whether the rule is true or false. Although Wason (1968) examined the effects of various selection instructions (e.g., to prove the rule true), selection instructions became a factor of interest when proposed as an explanation for the thematic content effect (Yachanin & Tweney, 1982; Yachanin, 1986). Yachanin (Yachanin, 1986; Yachanin & Tweney, 1982) observed that facilitation with thematic content rules occurs when subjects are instructed to determine if the rule is being *violated*, as opposed to instructions to determine if the rule is *true or false*. Several researchers have suggested that true/false instructions are ambiguous, subject to misinterpretation, and more difficult than violation instructions (Yachanin & Tweney, 1982; Valentine, 1985). Yachanin (1986) argues that the task of checking for

violations of a rule is easier than that of determining a rule's truth or falsity. The former involves only the evaluation of a rule given as true, while the latter requires consideration of the rule as true and of the rule as false. Put another way, violation checking involves the testing of a single hypothesis, but a true/false assessment involves the testing of a dual hypothesis. Because of the increased cognitive load for true/false assessments, subjects may adopt "short-circuiting strategies" (Yachanin, 1986, p. 21) resulting in poorer performance for true/false instructions than for violation checking.

Several researchers have investigated performance differences on abstract and thematic versions of the selection task, using true/false or violation checking instructions (Chrostowski & Griggs, 1985; Valentine, 1985; Yachanin, 1986; Kroger, Cheng, & Holyoak, 1993). Although it is clear that violation checking instructions do not by themselves produce facilitation, violation instructions do produce better performance than do true/false instructions for thematic rules. Violation checking instructions have generally not been found to facilitate performance on abstract versions of the task, but do on thematic content versions (Griggs, 1984; Chrostowski & Griggs, 1985; Yachanin, 1986; Valentine, 1985).

While research has demonstrated a superiority for violation instructions over true/false instructions for thematic content, we observed that the thematic content rules for which reliable facilitation has been demonstrated are primarily regulations (Johnson-Laird, Legrenzi, & Legrenzi, 1972; Griggs & Cox, 1982; D'Andrade, described by Griggs, 1983). These regulations are conventional rules which have been established to hold a certain status in the world. That is, conventional rules are intended to be interpreted as givens. These rules may be followed or may be violated, but their truth or falsity is not reasonably contemplated. By way of example, consider that you have established a rule stating, "If a person enters my office, that person must not smoke." It is clear that you have established this rule to be taken as a regulation by persons wishing to enter your office. The truth or falsity of the rule is not in question. However, the rule may be violated, and checking for violations of the rule is rational and relevant.

Cheng and Holyoak (1985, 1995) assert that facilitation on the selection task will be observed when a violation checking scenario and the rule's content identifies the rule as a regulation, and a pragmatic reasoning schema is applied. For example, the rule, "If a person is drinking beer, then that person must be over 19 years of age," is clearly a conventional regulation, for which a permission schema and violation checking is warranted. We argue that these conventional rules, which are characterized by their pragmatic content, can reasonably be checked for violations, but not truth or falsity. We suggest that the facilitation previously demonstrated for thematic content rules with violation instructions is tied to the pragmatic content of the conventional rules which have been used.

Although pragmatic content rules have been employed as thematic content rules, they comprise only a subset of possible thematic rules. An everyday example of a non-pragmatic, thematic rule could be stated as such: "If it is a stop sign, then it must be red." Although this rule is of thematic content, it should not invoke a pragmatic reasoning schema, as there are no preconditions which would regulate voluntary human action in this rule (Cheng & Holyoak, 1985). Non-pragmatic rules may be

stated between categorical relationships (e.g., if it is a dog, it must be an animal), conceptual features (e.g., if it is a stop sign, it must be red), and causal relations (e.g., if it is raining, it must be wet outside). In contrast to pragmatic rules, violation checking is not pertinent to non-pragmatic rules. For example, given our knowledge of categorical relations, it is difficult to imagine what would comprise a violation of the rule, "If it is a dog, it must be an animal." Non-pragmatic rules, however, may be more reasonably considered as either true or false. For example, consider the rule, "If it is a bird, it must fly." It is the case that we can determine whether this non-pragmatic rule is true or false, in other words, whether it represents an actual condition of the world. That is, "If it is a bird, it must fly" represents a *possible* state of the world that may be evaluated for truth or falsity, but which may not reasonably be checked for violations. In contrast, pragmatic rules, such as "If a person enters my office, that person must not smoke," represents a *given* state of the world which may be evaluated for violations, but not truth or falsity.

The present study compared the effects of true/false and violation selection instructions on subjects' performance when reasoning about rules of differing thematic content. Two types of thematic rules were used: pragmatic content rules and non-pragmatic rules. Subjects reasoned about these rules under instructions to either determine whether the rules had been violated or determine whether the rules were true or false. We argue that the facilitation observed for violation instructions is tied to the pragmatic nature of previously used thematic rules. Given our arguments about the relative applicability of violation and true/false instructions to pragmatic and non-pragmatic rules, we predicted that violation instructions would produce superior performance on pragmatic rules, whereas true/false instructions would produce superior performance on non-pragmatic, thematic rules. This prediction stands in contrast to previous views of true/false instructions. If true/false instructions produce more cognitive load or are more ambiguous than violation instructions (Yachanin, 1986; Yachanin & Tweney, 1982), violation instructions would be expected to facilitate reasoning on all thematic rules, regardless of their pragmatic or non-pragmatic content.

Method

Subjects

Subjects were 36 undergraduate students at the University of Louisville, who received credit for their participation toward fulfillment of an introductory psychology course requirement. None of the subjects had previously encountered the Wason card selection task.

Design and Materials

Subjects were tested in one of two instruction conditions: violation or true/false. Each subject was asked to reason about three pragmatic and three non-pragmatic thematic content rules. These factors constitute a 2 X 2 mixed design, with instruction type as a between subjects factor and rule content as a within subjects factor. Subjects randomly received either all three pragmatic rules first or all three non-pragmatic rules first. Ordering of the rules within each rule content type was also randomized.

| Selection | True/False Instructions | | Violation Instructions | |
|-----------------|-------------------------|---------------------|------------------------|---------------------|
| | Pragmatic rules | Non-pragmatic rules | Pragmatic rules | Non-pragmatic rules |
| p, not-q | 17 | 28 | 39 | 0 |
| p, q | 11 | 22 | 11 | 29 |
| p | 22 | 11 | 11 | 17 |
| q | 5 | 5 | 0 | 5 |
| not-p | 5 | 0 | 0 | 0 |
| not-q | 0 | 5 | 0 | 0 |
| not-p, q | 0 | 0 | 5 | 5 |
| not-p, not-q | 5 | 0 | 0 | 0 |
| p, not-p | 0 | 0 | 0 | 5 |
| q, not-q | 0 | 0 | 5 | 5 |
| p, not-p, q | 11 | 5 | 0 | 5 |
| p, q, not-q | 11 | 11 | 0 | 22 |
| p, not-p, not-q | 5 | 0 | 0 | 0 |
| not-p, q, not-q | 0 | 11 | 0 | 0 |
| p, q, not-q | 0 | 0 | 11 | 0 |
| all | 5 | 0 | 5 | 0 |
| none | 0 | 0 | 11 | 5 |

Table 1. Percentage of subjects selecting each combination.

Three pragmatic rules were used. A drinking age rule served as one of these rules, "If a person drinks beer, that person must be over 21 years old." Two other rules were developed for the task. These two rules read as follows: "If you earn income in Kentucky, you must pay federal income tax" and "If a person registers for psychology 322, that person must have taken its prerequisite, psychology 201."

Three non-pragmatic, thematic rules were developed, representing three possible relations: a categorical relation, "If it is a banana, then it must be a fruit"; a conceptual relation, "If it is a bird, then it must have wings"; and a causal relation, "If a person takes cyanide, that person must die."

Procedure

Subjects were tested in small groups of up to six, and were randomly assigned to instruction conditions. The rules were presented to subjects in a booklet with an initial page of instructions, which subjects read themselves. The violation instructions read as follows:

Suppose you are from a different country and you hear about some rules that people follow in the United States. For example, you hear that in this country, "If you want to mail a letter, you must put a stamp on the envelope." Your task in this experiment is to determine if various rules have been violated.

The instructions for the true/false condition were the same, except the last line read, "Your task in this experiment is to determine if various rules are true or false."

Each page of the booklet contained one rule. Following presentation of the rule, subjects saw four "cases" representing the P, Not-P, Q, and Not-Q conditions. For each

case, subjects were asked to decide whether they would need to select this case in order to test whether the rule was true or false (or had been violated). Subjects were instructed to circle "yes" if they would definitely need to select that information in order to decide if the rule is true or false, or to circle "no" if they did not need that information. Subjects in the violation condition received the same materials, except that references to true/false were replaced with references to violations.

Results and Discussion

The percentage of subjects selecting the P and Not-Q combination is shown in Table 1. For each rule, selection of the normative P and Not-Q combination was scored as 1 and selection of all other responses was scored as 0. An analysis of variance on these scores revealed no significant main effects for either rule content type or instruction type, but a significant interaction between these two factors, $F(1,34)=5.17, p<.03$. This interaction indicates that violation instructions facilitated performance for pragmatic content rules, while true/false instructions produced better performance for non-pragmatic content rules.

Table 1 also shows the percentage of subjects selecting patterns of information other than the normative p and not-q combination. Analyses of variance were also performed on the scores obtained for these non-normative responses. These analyses failed to reveal any significant main effects or interactions of rule content or instruction type.

The results for the P and Not-Q responses are striking, as it appears to be the first time that true/false instructions have produced performance superior to violation instructions on thematic materials. True/false instructions have typically been characterized as being more difficult and cognitively demanding (Yachanin, 1986). If so, violation instructions

should produce better performance relative to true/false instructions for all thematic materials. However, we found that true/false instructions produce facilitation relative to violation instructions for some kinds of thematic materials, specifically, non-pragmatic rules. Thus, our findings do not support the interpretation of true/false instructions as inherently more difficult or resulting in the adoption of nonlogical reasoning strategies (Yachanin, 1986). If this were the case, then violation instructions should be expected to facilitate reasoning on all kinds of thematic rules.

We believe our result is due to the intrinsic difference in status of pragmatic and non-pragmatic thematic rules. Pragmatic rules that embody conventional regulations are taken as givens in the world. As such, they are appropriately checked for violations, but are less suited to tests of truth or falsity. Conversely, non-pragmatic rules may be stated that are either true or false and may be evaluated as such. However, these non-pragmatic rules are not subject to violation checking. The results of the present study support our contention, demonstrating differences in thematic content, for which violation checking or true/false instructions may be more or less applicable. Most interestingly, the study revealed conditions under which reasoning in the selection task paradigm may be supported by true/false instructions.

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