



Conditional Reasoning: Scenario or context effects*

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INTRODUCTION

The ability to solve problems involving conditional relationships (vg. “*if p... then q*”) has a central role not only in the everyday reasoning but also in the scientific inference. The aim of this paper is concerned with context effect about conditional human reasoning. The understanding of this effect is a principal phenomenon to be discussed if we are interested to investigate how people consistently do reason in the daily life.

The question of what is the importance of scenario or the context in everyday reasoning may be answered in many different ways and from many different perspectives. There are several theories that argue people use internalized inference logical rules (Braine, 1978; Rips, 1983, 1984; Braine & cols., 1984). These approaches have proposed a syntactic view of human reasoning.

* This paper was presented at the *FIFTH CONFERENCE OF THE EUROPEAN SOCIETY FOR COGNITIVE PSYCHOLOGY - ESCOP*, celebrated in Paris, Societé Francaise de Psychologie-UNIVERSITÉ DE PARIS-SUD (September, 12-16, 1992).

In contrast, other authors have proposed that people reason using pragmatic reasoning schemas or abstract knowledge structures induced from ordinary life experiences, as permissions, obligations, and causations schemas (Cheng & Holyoak, 1985, 1989; Cheng, Holyoak, Nisbett, & Oliver, 1986).

Cheng & cols' investigations provide support for the view that people often reason using knowledge structures of intermediate level of abstraction and context sensitives, rather than purely syntactic rules or domain-specific experience that cued relevant solutions in memory (Griggs y Cox, 1982; Griggs, 1983).

Most of the research for the past twenty years examined pragmatic reasoning in Wason's selection task (Wason, 1966, 1968; Wason & Johnson-Laird, 1972). The previous studies examine many experimental manipulations, and this experimental task has generated a larger literature (see Griggs, 1983, Evans, 1989, Johnson-Laird, 1991 for a review). A facilitation content effect was first reported (Wason & Shapiro, 1971; Johnson-Laird, Legrenzi, & Sonino Legrenzi, 1972) but subsequent research failed to replicate the thematic effect (see Griggs, 1983 and Wason, 1983, for a review). During the past decade the conclusion about the "elusive thematic material effects" in Wason's selection task (Griggs y Cox, 1982) was that the performance on thematic problems can be facilitated, but this facilitation was "more limited than originally thought and brought about by a very different mechanisms than originally proposed" (Jackson & Griggs, 1990, p. 354).

During the 90's Jackson & Griggs (1990) also found the pragmatic reasoning schemas effect to be very "elusive". They examined the pragmatic reasoning schema theory of deduction reasoning and established that the

finding of facilitation on abstract versions of the selection task is not the result of evoking pragmatic reasoning schemas, but it was dependent upon two presentation factors. They conclude *"the results of the present experiments mirror those observed throughout the past 20 years of research on the selection task in that a result can be changed dramatically by only a subtle change in problem presentation"* (p. 371).

In contrast, this study explores the pragmatic reasoning schemas effect in everyday conditional reasoning, but real-world reasoning problems, that hold interest for the subjects, were used. The conditional arguments were included in narrative texts; these texts represented scenarios of real world. Previous investigations about syllogistic inference (Henle, 1962; Evans, Barston & Pollard, 1983; Valiña & De Vega, 1988) and conditional reasoning (Piper, 1985) used narrative texts.

The experiment reported here have been designed to explore the effects of the type of context (causal and promises/threats), the congruence of the text and the factual relationship between antecedent and consequent on the conditional everyday reasoning.

METHOD

Subjects

120 students (75 females and 45 males; mean age 17 years 1 month) at the college level, in Santiago de Compostela (Spain) participated in this experiment.

The subjects acted as unpaid volunteers. They have not received any instruction in logic.

Design

A 2 x 2 x 3 x 4 (type of content x congruence x degree of factual relationship x type of rule) factorial design with repeated measures on the last two factors was used. The *type of context* (causal and promises/threats) and the *congruence between the factual congruence explicit in the story and the logic conclusion* (congruent vs. incongruent) were manipulated between subjects, with 30 subjects randomly assigned to each experimental group.

The last two factors were *degree of factual relation between antecedent and consequent of major premise* (deterministic, probabilistic and without relation) and *type of conditional rule* (MP, MT, AC and DA).

The dependent measures were: (a) correct answers to problems of conditional inference and (b) subjects' certainty in the answer selected.

Material

Eight variations of the 24 conditional reasoning test were used. Tests booklets were constructed, each containing one instruction page, and the conditional reasoning problems presented on separate pages.

There were 24 conditional arguments for each of two different contexts: (a) Causal (vg. “*if you are on diet then you will lose weight*”) or (b) Promises/Threats (vg. “*if she is not agree with his pressures then he will lose her work*”). Each booklet was prepared containing conditional arguments according to the type of logical rule (MP, MT, AC and DA) and the probability of factual relationship between antecedent and consequent of major premise (deterministic, probabilistic or without relation). These conditional sentences were based on previous experimental work (see Valiña Seoane, Martín, Fernández-Rey & Ferraces, 1992).

In this experiment the conditional reasoning problems were presented in the context of narrative texts. The procedure was the same as that used in previous experimental investigation about syllogistic reasoning (Valiña & De Vega, 1988). 48 short stories about scenarios of the daily life were described in these texts.

The steps in constructing an everyday scenarios can be outlined as follows: (1) First the principal persons and their situation were presented (vg. *“Marta, that is chemistry teacher, teaches laboratory practical classes to her students”*), (2) The *“if p ... then q”* after that conditional sentence were included in the context of these previous situation (vg. *“Before beginning the class he noticed her students they were to work with very dangerous substances, in order that they must carefully pay attention her instructions, and also they were advised to put they laboratory coat, but as someone of them did not want do it she noticed them that if sulphury acid spilled on their clothes then those were burnt”*), (3) The *“p”*, *“not-p”*, *“q”* or *“not-q”* action is presented (vg. *“During the practice the clothes of a student girl, who had not wore laboratory coat, were splashed with sulphury acid”*). Then the MP, MT, AC or DA conditional rules were determined. Finally (4) the congruence between the factual consequence explicit in the story and the logic conclusion is manipulated. A congruent ending (vg. *“The opinion of that student was changed by the incident, and she resolved to wear her laboratory coat in order to the event did not happen again”*) or an incongruent ending (vg. *“The opinion of that student was not changed by the incident and she went on with one's work without to wear her laboratory coat”*) finished the story.

Finally, a list of alternative conclusions from which the subject must select was presented. An affirmative, negative and non-propositional conclusions were presented for each item.

The length and accessibility of vocabulary of each story was controlled. The order of the 24 conditional problems was randomized and the items were presented in this order and another reverse order.

Task and Procedure

30 subjects were assigned at random to each of four experimental groups. All participants were given one version of the booklets. In conditions (a) and (b) the subjects received 24 reasoning problems presented as a story with causal conditional premises (*causal context*). In conditions (c) and (d) the subjects received another 24 conditional reasoning problems with promises/threats context in the premises (*promises/threats context*).

Half of the subjects received a congruent story (groups 1 and 3) and the other half received an incongruent story (groups 2 and 4). Within each of the four main groups half of the subjects received the problems in a randomized order and the remaining ones received in reverse order.

Subject's task was assumed that the two premises of each conditional argument are true and to select from a list of three alternatives the conclusion followed from such premises. The subjects were required to rate the security in their selection of the answer; a five-point scale was used.

The experiment was run in four experimental sessions. The instructions were read to the subjects, and they were asked to read them to themselves again. Before the test problems, subjects had two practice items using conditionals arguments.

Questions were solicited and finally they were allowed to work at their own speed. They were given unlimited time to carry out the task.

Results

A) Correct Answers

A 2 x 2 x 3 x 4 (type of context x congruence x degree of factual relation x type of rule) ANOVA with repeated measures for the last two factors was computed. There were significant main effects for congruence ($F(1, 116) = 21.68$; $p < .0001$); degree or probability of factual relation between antecedent and consequent ($F(2, 232) = 36.25$; $p < .0001$), and type of rule ($F(3, 348) = 29.27$; $p < .0001$). There were also significant interaction between congruence x type of context ($F(1, 116) = 7.05$; $p < .0091$), factual relationship x type of context ($F(2, 232) = 7.92$; $p < .0005$), type of context x type of rule ($F(3, 348) = 6.71$; $p < .0002$), factual relation x type of rule ($F(6, 696) = 56.72$; $p < .0001$) and congruence x type of rule ($F(3, 348) = 14.62$; $p < .0001$). There was not main effect involving type of context.

The pattern of results was the predicted by our hypothesis. The congruent version of reasoning problems produced a significantly higher rate of correct responses than the incongruent version with all contexts (causal and promises/threats).

As it was predicted, the conditional inference task is easier to perform when it involves realistic material. Moreover, the probability of factual relation between the two components of conditional sentences had effects on subjects' performance.

There were more correct answers to problems with the deterministic relation between the two components of major premises than those involving a probabilistic relation or without-relation between antecedent and consequent. These differences were significant (Tukey's test, $p < .05$). Inspection of paired comparisons for the factual relationship x type of

context interaction showed that the subjects made more errors in causal content problems than those with promises/threats only the deterministic condition ($p < .05$).

The congruence \times type of context interaction was also explored. Performance on the causal context was significantly better than performance on the promises/threats problems with the congruent version but the Tukey's test comparisons ($p < .05$) indicated also significantly worse performance on the incongruent causal context than those with promises/threats content.

For the thematic conditional arguments, the mean percentage of correct responses for MP, MT, AC and DA rules were 58.18%, 47.78%, 38.45% and 34.85%, respectively. There were no significant differences for problems involving AC and DA rules, but post hoc comparisons (Tukey's test) showed that conditional AC and DA arguments were significantly ($p < .05$) more difficult than the corresponding MP and MT. On the other hand, MP arguments were consistently ($p < .05$) easier than MT arguments.

The comparison (Tukey's test) of the mean within each type of rule indicated that arguments without factual relationship were significantly easier for AC rules. For MP, and MT rules arguments involving a major premise with deterministic relation were significantly ($p < .05$) easier those involving a probabilistic or without relation between the components. Finally, the probabilistic relation showed better performance for DA problems.

Inspection of paired comparisons for the congruence \times type of rule showed that the subjects made more errors with the incongruent version on the MP and MT inference rules ($p < .05$). But none of other comparisons were significant.

Finally, Tukey's test comparisons indicated that subjects make more errors with causal context in MT and DA reasoning problems, but they particularly find difficult on the MP and AC problems with promises /threats context.

B) Subjects' Certainty

There was significant main effect for the congruence ($F(1, 216) = 9.36$; $p < .0028$), degree of factual relationship between the two components of mayor premise ($F(2, 232) = 9.17$; $p < .0001$) and type of conditional rule ($F(3, 348) = 6.88$; $p < .0002$). It was also significant the interaction type of content x degree of factual relation x type of rule ($F(6, 696) = 6.90$; $p < .0001$).

The incongruent items resulted in significantly worse confidence than either of other congruent problems. Tukey's tests comparisons showed that judgements concerning deterministic relation between the two components of conditional sentences are more confidence than judgment concerning probabilistic relation or no relation between antecedent and consequent.

Inspection of paired comparisons for the type of context x probability of factual relationship interaction showed that the subjective certainty in the correct answers is greater for the promises/threats context with deterministic relation; but the subjects have more confidence with the probabilistic sentences on the causal context problems.

Finally, a final area to be briefly examined concerned the degree of factual relation x type of rule interaction. In MP problems, subjects possessed more confidence with the deterministic conditional sentences than with the other relationships. The probabilistic relations had greater confidence scores with MT and AC problems, whereas subjects' certainty with NA arguments

improved significantly ($p < .05$) when these arguments containing major premises without factual relationship between antecedent and consequent.

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