ATMOSPHERE AND CONVERSION ERRORS IN SYLLOGISTIC REASONING WITH CONTEXTUAL MATERIAL AND THE EFFECT OF DIFFERENTIAL TRAINING

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

R. PAUL STRATTON

1967

ABSTRACT

ATMOSPHERE AND CONVERSION ERRORS IN
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by R. Paul Stratton

Several previous studies have shown that Ss untrained in the use of formal logic accept very predictable erroneous conclusions when solving syllogism problems. Two types of logical operations have been proposed to account for such consistent behavior. The atmosphere effect (Woodworth and Sells, 1935; Sells, 1936) was defined as the influence which the context, or tone, of a situation has upon the completion of a task. It was assumed that, if S does not understand, or does not use, the given logical relationships, the conclusion will be based upon the structural features of the syllogism, i.e., the quantifiers and qualifiers. Thus, for like premises a like conclusion would be predicted. For unlike premises one negative premise would predict a negative conclusion, and one particular premise would predict a particular conclusion.

The conversion hypotheses (Chapman and Chapman, 1959) assume that the logical relationships are understood, with the exception that an A or O premise may be invalidly converted. Thus, after making an invalid conversion, a conclusion will be deduced by the otherwise valid operations. This was proposed as an alternative explanation to the atmosphere hypotheses for certain items. The predicted responses are the same for those items.

Because these contradictory hypotheses predicted erroneous conclusions equally well for certain syllogisms, Simpson and Johnson (1966) trained against each error separately. On items where only the atmosphere hypotheses predicted the favored conclusion, the groups receiving anti-atmosphere error training produced the least number of errors and the greatest number of correct responses. On the conversion error items the anti-conversion error training did not influence performance any more than other training procedures. For untrained Ss the correlation between the number of atmosphere and conversion errors was only -.12. Several methodological faults in this experiment, however, indicated the necessity of replication.

The present experiment used a transfer-of-training paradigm to detect changes in performance due to differential training. The premises of the syllogisms were of neutral emotional content and used unfamiliar, or nonsense, words for terms. These were included in a paragraph to approximate complex reading material. The pretest and posttest included 12 atmosphere error, 12 conversion error, and 12 determinate items. Ss were assigned randomly to six groups of 40 Ss each. These groups received written instructions against the atmosphere, conversion, or equivalence errors. One group received both anti-atmosphere and anti-conversion error instructions. A control group received the introductory paragraph and the definition of "some" which the training groups had received. The other control group received no training instructions.

The results indicated that the errors made on syllogisms of contextual material were similiar in kind and amount to

those made on syllogisms of symbolic or verbal material. A correlational analysis of the relationships between performance on error items indicated a substantial dependence. Both the number of errors and the number of correct responses for the error items were correlated at a statistically significant level, i.e., between .347 and .589. This was not predicted from past research and had particular import since only the atmosphere hypotheses could predict the errors for both types of items. On the atmosphere items no predicted error could result from an invalid A or O premise conversion. Partial correlations showed that these correlations were not due to a covariance with reading comprehension, numerical ability or tendency to respond "none of the above" to all items. These results were interpreted as evidence against the proposed conversion error. Other evidence, however, is necessary to strengthen the generality of this conclusion. Differential training would have supplied further evidence, but no type of training instructions produced a significant change in performance. Possible causes of this and improvements in this procedure were discussed. Further research in this area was also suggested.

Approved Donald M. Johnson
Committee Chairman

Date May 12, 1967

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By

R. Paul Stratton

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

DEPARTMENT OF PSYCHOLOGY

1967

TO KARIN

ACKNOWLEDGMENTS

Dr. Donald M. Johnson's support and assistance in this endeavor have been invaluable. I wish also to thank Dr. Terrence M. Allen of the Department of Psychology and Dr. Herbert E. Hendry of the Department of Philosophy for reading and criticizing this manuscript. To my wife, Karin, I owe a debt of gratitude for her unending encouragement and understanding.

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INTRODUCTION

The term reasoning has had a history of varied usage and is used by psychologists today to refer to the solution of problems by logical operations. Investigations of such operations have used a wide variety of problems ranging from word series to algebra problems. Reasoning occurs most obviously, however, during the solution of problems of formal logic. The syllogism is such a problem and has received wide acceptance as an example of deductive reasoning. A categorical, or Aristotelian, syllogism is an argument composed of two categorical premises and a categorical conclusion. These propositions together contain three and only three terms, each of which is used only twice. A middle term appears in each premise, and the other term from each premise appears in the conclusion. Thus, there may exist valid and invalid syllogisms. Traditionally these propositions are called the major and minor premises and the conclusion. Problems of this nature with more than three terms are called sorites or polysyllogisms.

Syllogisms have frequently been used in general intelligence tests, and the ability to solve them has been found to be influential in other intellectual abilities (Guilford, 1959; Guilford and Merrifield, 1960; Guilford and Hoepfner, 1966). In addition, they have been used in psychological

studies of behavioral pathologies (e.g., Arieti, 1955; Gottesman and Chapman, 1960), of emotion and attitudes (e.g., Gorden, 1953; Henle and Michael, 1966), of semantic learning and structure (Lippman, 1966), of verbally mediated learning (Frase, 1966), and of problem solving (e.g., Moore and Anderson, 1954; Newell, Simon, and Shaw, 1958).

Investigations of problem solving processes, however, tend to underemphasize the role of reasoning when defined as the use of logically valid inference patterns. For example, Bruner, Goodnow and Austin (1956) concluded "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)." The study of errors in syllogistic reasoning has yielded an impressive amount of evidence which would indicate that the logic of reasoning does not correspond to the psychology of reasoning. Specifically reasoning can be influenced by structure, attitudes, or emotions (e.g., Morgan and Morton, 1944). Unfortunately such a theoretical question as the presence or absence of valid reasoning processes has only been tested by the ability to discriminate valid and invalid solutions to syllogism problems. Thus, it becomes an inferred process. If one asserts that errors of discrimination in solving such problems can be attributed to other factors, for example, not understanding the meaning of "valid," the presence of valid reasoning processes may be argued for. This is the position taken by Richter (1957),

Stewart (1959, 1960), and Henle (1962). The present experiment will test two hypotheses which are opposed on this question and consequently on the proposed sources of error in syllogistic reasoning.

Before further discussion is possible certain terms must be defined. For a more thorough discussion of the elements of formal logic see an introductory logic text such as Cohen and Nagel (1934) or Copi (1954).

The categorical propositions of a syllogism are noted symbolically by the letters A, E, I and O.

Name	Expression	Symbol
Universal Affirmative	All S's are P's.	A
Universal Negative	No S's are P's.	E
Particular Affirmative	Some S's are P's.	I
Particular Negative	Some S's are not P's.	O

The major premise of a syllogism states the relation between the middle term and the predicate of the conclusion. The relation between the middle term and the subject of the conclusion is given by the minor premise. The conclusion is deduced from the major and minor premise relations and is valid or invalid according to certain formal rules.

To distinguish between the possible relations of the subject (S) and predicate (P) of the conclusion to the middle term (M) in the major and minor premises, four figures have become standard. Note, any of the categorical propositions may be used as major or minor premises or as a conclusion.

	Figure I	Figure II	Figure III	Figure IV
Major premise	M-P	P-M	M-P	P-M
Minor premise	S-M	S-M	M-S	M-S
Conclusion	S-P	S-P	S-P	S-P

The mood characterizes a syllogism by denoting the logical structure with symbols for major premise, minor premise, and conclusion, in that order, and with the figure. Thus, a syllogism may be characterized by AII figure I. From this information the syllogism may be reproduced,in symbollic form, and the validity or invalidity may be ascertained.

The validity of a syllogism fundamentally depends upon the possible collateral truth of the premises and conclusion. A syllogism is valid only when, if the premises are true, the conclusion would have to be true also, even though the premises may in fact be false. One of the several methods of determining the validity of a syllogism is its conformity to certain rules of validity as given by Cohen and Nagel (1934, p. 79):

Rules of quantification

1. No valid syllogism follows from two particular premises.
2. If one premise is particular, then the conclusion must be particular.

Rules of qualification

1. No valid syllogism follows from two negative premises.
2. If one premise is negative, the conclusion must be negative.

Rules of distribution[1]

1. The middle term must be distributed only once for the syllogism to be valid.
2. A term can be distributed in the conclusion if and only if it is distributed in its premise.

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[1] "Distribution" means that all members of a class which are designated by a term have been referred to by the proposition. A term is distributed if it is the subject of a universal proposition or the predicate of a negative propositon.

That people make errors when working such syllogism problems is reasonable and not surprising. For this reason philosophers have taught courses in formal logic, and psychologists have taught their students the principles with which to logically relate research findings. The errors made by students when solving syllogisms were first reported in the psychological literature by Wilkins (1928).

Using undergraduates of Columbia College, she found the frequency of acceptance of invalid conclusions to syllogisms of varied content. The syllogistic fallacies most frequently accepted were drawing a conclusion from two particular premises and the undistributed middle term. Others were illicit major and minor terms and negative conclusion from affirmative premises. The converse of a proposition was also frequently accepted as a valid inference. With mood and figure constant the decending order of content difficulty was: unfamiliar (long, scientific terms), symbolic, suggestive (false conclusions), and familiar content.

Atmosphere hypotheses

To Woodworth and Sells (1935) the syllogism was a "promising lead in the experimental study of thinking (p. 451)." A syllogism stated in purely symbolic terms possessed the qualities of nonsense syllables in memory experiments for they were free from extraneous associations and truth or falsity. Attempting to discover the psychological principles involved in the acceptance of invalid syllogistic inferences, Woodworth and Sells formulated three sources of error. Ambiguity of

the language operates especially through the quantifier "some." By the conventions of formal logic "some" means "some and perhaps all" or "at least one," precluding the inference "some X is not Y" from the proposition "some X is Y." A principle of caution was formulated to account for the preference of a particular conclusion over a universal one.

The "atmosphere" of a syllogism is of principal interest here since the definition of "some" and cautious responses may be reasonably well controlled by instructions and test format. The "atmosphere," or "tone," of a syllogism may be universal or particular, and affirmative or negative. Whichever it is, it creates a sense of validity for the corresponding conclusion. Thus, the primary atmosphere hypothesis would predict that, when the two premises are of the same type, a corresponding conclusion would be preferred. For unlike premise combinations, two secondary hypotheses were postulated. (1) A particular premise creates a "some" atmosphere, even though the other may be universal. (2) A negative premise creates a negative atmosphere, even though the other may be affirmative.

In summary, the atmosphere hypotheses predict:

A conclusions for AA premises
E conclusions for AE or EE premises
I conclusions for AI or II premises
O conclusions for AO, EI, EO, IO or OO premises

In addition, the principle of caution would predict I and O conclusions for AA and EE premises, respectively.

Woodworth and Sells presented data from Wilkins (1928) which supported these predictions.

Sells (1936) describes the atmosphere hypotheses which predict conclusions to syllogisms as one specific instance of an "atmosphere effect" which is akin to a determining tendency, a mental set, or an Einstellung. It is "a temporary set of the individual, arising within a situation (e.g., problem) to complete the task with that one of several alternative responses (e.g., an inference or judgment) which is most similiar to the general trend or tone of the whole situation (e.g., problem) p. 7." Thus, the atmosphere effect operates in any problem, such as perceptual phenomena or judgment, where the context or tone of the situation may influence the response choice. The syllogism, therefore, was used by Sells as a preparation to demonstrate the existence of the atmosphere effect and its interaction with variables such as age, sex, and intelligence.

Replicating the results of Wilkins (1928), Sells found a similiar distribution of formal logical fallacies and found abstract (symbolic) syllogisms to be about 15% more difficult than concrete (verbal) syllogisms in familiar terms. In a second experiment he used abstract syllogisms in all combinations of A, E, I and O premises and conclusions. Subjects (Ss) were to respond "absolutely true," "probably true," "indeterminate" or "absolutely false." For each pair of premises he found the percent of the Ss who selected "absolutely true" and "probably true" to each A, E, I or O conclusion. For each such item the response predicted by the atmosphere hypotheses plus the principle of caution was chosen by substantially more Ss than other invalid conclusions. Thus, the

atmosphere effect plus the principle of caution was interpreted as explaining the predominant pattern of error responses in all invalid syllogisms.

Other evidence for the atmosphere effect came from the distribution of invalid conclusions in other studies. Sells and Koob (1937) present the materials and method for a classroom demonstration of the atmosphere effect in syllogisms where S supplies his own conclusion. Using these Sells and Koob obtained data which demonstrated the atmosphere effect in self-produced conclusions to syllogisms.

Morgan and Morton (1944) used abstract and concrete syllogisms of neutral content in a five-choice multiple-choice format and found 67% and 60% of the erroneous conclusions could be predicted by the atmosphere effect for both abstract and concrete syllogisms, respectively. If, however, the syllogisms are of an emotional content, invalid conclusions were more influenced by congruency with one's own convictions than by logical structure.

The presence of an atmosphere effect in problems other than syllogisms has been documented by Hunter (1957a,b). Hunter (1957 a) used a proportion problem where two terms were related when the third was held constant. When Ss were asked to produce their own solution, 63% gave a response which was not determined by the relationships involved but by the formal structure of the problem. Asked what their first impression of the solution was, 73% indicated the atmosphere effect predicted solution. Testing 11- and 16- year olds with simple three-term series problems, Hunter (1957 b) found 11-year olds

based their solutions on structural relationships rather than logical ones, whereas 16-year olds made more articulated judgments according to the logical structures of the problems.

Having thus been established and verified, the atmosphere effect in syllogistic reasoning has received general acceptance. So much so that until 1957 no other explanation of errors in syllogistic reasoning had been proposed, and it has received favorable mention in such well-known texts as Underwood (1949), Woodworth and Schlosberg (1956), and Stevens' Handbook (Miller, 1951).

Conversion hypotheses

Another explanation of errors in syllogistic reasoning was proposed by Chapman and Chapman(1959). After a thorough re-examination of Sells' (1936) research, Chapman and Chapman criticized the atmosphere hypotheses on several points: (1) The secondary atmosphere hypotheses predict a conclusion with wording other than that of either premise, i.e., for a universal negative and a particular affirmative, a particular negative is predicted . This is contrary to the basic character of the atmosphere effect. (2) The principle of caution is not justified, because it is an artifact of the true-false format Sells used. And (3) Sells apparently had not labeled the mood in the conventional manner, preferring to label it in terms of premise order rather than in terms of major and minor premises. Thus, although all of his invalid syllogisms were invalid, one would not have been able to infer this from Sells' mood distinctions.

Convinced that they had due cause, Chapman and Chapman then devised a symbolic test of 42 experimental items of which there were three syllogisms for each of the 14 premise combinations with no logical conclusion in one or more figure, and of 10 filler items for which a conclusion did follow logically. The test was of multiple-choice format with alternatives A, E, I, O and "none of these." The instructions defined the task, the term "some," and the use of "none of these." The percentage of Ss selecting each alternative was presented as a tabulation of errors to syllogisms for which there were no valid conclusions. The results were impressive. Accuracy was low as one would expect from a test where 80% of the answers were "none of these." For most items a single alternative was chosen by the majority of the Ss, and that alternative was preferred regardless of premise order or figure for the same premise pair. Comparing their results with those predicted by the atmosphere effect (without the principle of caution), IE and OE premises had a preferred error of E while the predicted error was O. Also for EO premises the E and O alternatives were preferred almost equally. This they interpreted to mean, "the atmosphere predictions are not substantiated, we must look for other principles of explanation (p. 224)."

Their alternative explanation incorporated the invalid conversion of A and O premises and reasoning by probabilistic inference. Both Wilkins (1928) and Sells (1936) found that many Ss interpreted A and O propositions to mean that the direct converse was true. Thus, from "all X's are Y's" they inferred "all Y's are X's," and from "some X's are not Y's"

they inferred "some Y's are not X's." Whereas E and I propositions may validly be converted directly, the valid A conversion produces a negated subject and predicate, and the O proposition cannot be validly converted. Such invalid conversions are frequently consistent with reality, and, thusly, could be assumed to be in a person's repertoire of immediate inferences. The preferred conclusions of AA, EE, AI, and AO premise pairs may be deduced validly if one only assumes an invalid A and O conversion to be valid.

To deduce the remainder of the preferred conclusions the principle of probabilistic inference was necessary. Since Ss are not told that only strict deductive reasoning is allowed, they may reason that things that have common properties are probably the same kinds of things. This is a form of reasoning by insufficient evidence where the solution is probable, but one cannot know if it will be true for every instance of the situation. For example, given "some X's are Y's; some Z's are Y's" the conclusion that "some X's are Z's is probable since X and Z share property Y. When the syllogism is not in the second or fourth figure, S is assumed to restate a premise in the converse to make this relationship more apparent. Taken together these reasoning behaviors often lead to correct conclusions in everyday life, but may lead to erroneous conclusions which are disallowed by the traditional rules of the syllogism. The present experiment will not be directly concerned with probabilistic inference as a source of error. See Alberoni (1962), Cohen and Nagel (1934) and Henle (1962) for a more detailed analysis of subjective probability and

probabilistic inference in reasoning.

Equivalence hypothesis

That Ss so accept the invalid conversions of A and O premises is well verified by the evidence at hand. That they do so in the solution of a syllogism problem, however, is open to question. An alternative explanation of the acceptance of A conversions would be an inferred equivalence between the terms of the proposition which, then, would allow the conversion to follow logically, if necessary. By inferring an equivalence between the terms of a proposition, S would in effect be asserting that one term is a proper subset of the other. Thus, the union would include each and every element of both sets. Such relationships often correspond to our experience of reality, and frequently the copula "are" is used to denote such an equivalence. For example, while "all right angles are 90° angles," and "all 90° angles are right angles," are true statements, one does not follow logically from the other. In fact, the converse of a true A proposition is not always true. For example, "all cats are mammals" is true, but the converse, "all mammals are cats," is not. Usually the equivalence property of a relationship is determined by the meaning of the terms themselves, but the verb "are" can be used as a copula in either case. Where the meaning is indeterminable, however, as in syllogisms using unfamiliar or symbolic terms, one cannot make such distinctions, and an equivalence relationship may well be asserted. An unjustified inferred equivalence, called an equivalence error,

could account for and predict the errors made in those syllogisms which Chapman and Chapman explain by an A conversion. The present experiment will attempt to test this hypothesis by establishing the non-equivalence of the terms in the instructions.

The problem

It is apparent that the conversion and atmosphere hypotheses overlap in the errors they predict. For the AA, AE, AI and AO premise pairs both hypotheses predict the same error in the figures where no valid conclusions are possible. The data verify the predictability of these errors. These hypotheses differ, however, upon the proposed logical operations involved, as has been discussed before, and upon the basic assumptions they engender.

The atmosphere effect must assume that S does not understand or does not use the information given by the relationships between the terms of each proposition. S then relies on the structural properties, the context, of the situation for information on which to base his conclusion. The conversion hypotheses, on the other hand, assumes that S does understand the given relationships to the extent that he accepts the converse of one premise and with that converse proceeds to a valid conclusion. Thus, for syllogism problems the conversion hypotheses assume the invalid conversion to be the only error that is necessary to otherwise validly deduce the conclusion.

Were one to follow the procedures suggested by either hypotheses, a predictable invalid conclusion would be accepted as valid. A computer following the same instructions would arrive at the same conclusions. But, since both hypotheses

predict the errors equally well in syllogisms with an A or O premise and the existence of these errors has been documented, one must conclude that the method of tallying errors has a limited utility and a new method of comparison is necessary. Were a restricted training procedure to influence the usage of a particular logical operation, there would be strong evidence for the existence of that operation.

This was the approach taken by Simpson and Johnson (1966). A symbolic syllogism test was constructed of 12 atmosphere items of EE, OO, II, IO, and EO premises and 12 conversion of AO premises. For the IO premises both I and O conclusions and for EO both E and O conclusions were scored as atmosphere errors. Eleven filler items which had valid conclusions were used and called determinate items. Group 1 received the anti-atmosphere instructions which included a verbal description and a demonstration of the atmosphere error plus practice on six items not to be used later. Group 2 received the anti-conversion instructions for invalid A conversions and practice on propositions and their conversion. Group 3 received only a general warning about the difficulty of the syllogisms and the necessity of being careful. Group 4 received the instructions of Group 3 and the practice of Group 1. Group 5 was a control group receiving no practice or anti-error instructions.

The results of this experiment indicate the independence of performance on atmosphere and conversion error items. although 60-70% of the predicted errors were made, the correlation between atmosphere and conversion error scores was only

-.12. This was interpreted to mean "susceptibility to one type of error is practically independent of susceptibility to the other (p. 199)." Training produced similiar results. The anti-atmosphere group made more correct responses and less errors than other groups on the atmosphere items. The anti-conversion group, however, did not perform as well. The number of correct responses to conversion items was very low for every group, and the anti-conversion error group did not make the least number of errors as expected. The difference between groups for the number of conversion errors was statistically significant but was attributed to the large number of errorsmade by the untrained Group 5. The general warning and practice group, however, made substantially less conversion errorsthan any other group. The statistical significance of this was not mentioned and was not possible to calculate from the data. The procedure may be criticized on several points: (1) By not using a transfer-of-training paradigm the results were influenced by initial ability of the groups. (2) By scoring two alternatives as predicted atmosphere errors for the IO and EO items, the atmosphere hypotheses as stated by Sells (1936) were not accurately tested. (3) By training only against the invalid A conversion Ss could not be expected to improve performance on the nine O-conversion and two determinate items of the conversion error scale.

Material heretofore unused in syllogism experiments will be used in the present experiment. Two premises using unfamiliar words for terms will be included in a paragraph. An III figure I example follows (Appendix A includes the remainder

of the items used):

> As technology advances and natural petroleum resources become more depleted, the securing of petroleum from unconventional sources becomes more imperative. One such source is the Athabasca tar sands of northern Alberta, Canada. Since some tar sands are sources of refinable hydrocarbons, these deposits are worthy of commercial investigation. Some kerogen deposits are also sources of refinable hydrocarbons.
>
> Therefore:
>
> (1) All kerogen deposits are tar sands.
> (2) No kerogen deposits are tar sands.
> (3) Some kerogen deposits are tar sands.
> (4) Some kerogen deposits are not tar sands.
> (5) None of the above.

This is intended to demonstrate the existence of atmosphere and conversion errors in difficult reading material similiar to that found in textbooks. The recording of reasoning errors in contextual material has not been done even though Wilkins (1928), Sells (1936) and others have used familiar and nonsense verbal material. An example of such a syllogism is: "All troubles are insults; All insults are unpleasant occurences; Therefore, all troubles are unpleasant occurrences." Wilkins (1928) found the syllogisms using familiar words, symbolic, and unfamiliar words more difficult in that order. Note, however, that such syllogisms do not approximate a normal reading task. Similiar materials were also used in studies of the effect of emotion, attitude, or bias upon reasoning such as Janis and Frick (1943), Morgan and Morton (1944), Lefford (1946), Thislewaite (1950), Gordon (1953) and Henle and Michael (1956). For normative studies, however, nonsense material is preferred to familiar material because of its relative freedom from prior knowledge and attitude. After studying the mistakes made in reading paragraphs

by elementary school children, Thorndike (1917) concluded that accurate reading involved the elements characteristic of reasoning. His Ss apparently weighed each element in the paragraph and their organization relative to each other, selected proper connotations, and coordinated these many forces into a final understanding. Thus, he concluded reading appeared to involve some skill in some type of reasoning. This conclusion was was further substantiated by Davis (1942, 1946) through factor analysis of various reading tests and their components. He found two prominent factors; word knowledge and reasoning-in-reading. It is reasonable, then, that errors found in less complex material should also be found in paragraphs using unfamiliar terms.

To summarize, the present experiment will attempt to replicate the findings of Simpson and Johnson (1966) using contextual material and more sensitive design. A pretest and posttest will determine relative gain after training against the atmosphere, conversion, and equivalence errors. Specific hypotheses to be tested are:

Hypothesis I. On the atmosphere and conversion error items the largest number of errors will be predicted by the atmosphere and conversion hypotheses, respectively.

Hypothesis II. Performance on the atmosphere error items will not be dependent upon performance on the conversion error items.

Hypothesis III. For groups receiving specific training instructions against the atmosphere, conversion or equivalence error a decrease in errors or an increase in correct conclusions

will obtain only on error items against which the training instructions were directed.

METHOD

Subjects

Two hundred and ninety-three college freshmen and sophmores from an introductory psychology class at Michigan State University served as subjects for this experiment.[2] Of these 53 were eliminated from the final analysis, because they had had a course in formal logic, had missed one testing session or had one incomplete test (i.e., left two or more items blank; average number of blank items was 7.8 with a range of 2 to 23). Of the 240 remaining subjects 62 were males and 178 were females. By serial distribution of tests Ss were assigned without bias to six groups of 40 with 7 to 13 males in each.

Materials

The syllogisms used were of neutral emotional content incorporating unfamiliar words for terms. The categorical propositions were in a paragraph of relevant fictional material. The premise order was major, then minor. Varying lengths of paragraphs and steps to solution were distributed throughout both test and each scale. Items were in topical sequences up to six items long to increase Ss' interest and decrease difficulty due to novelty of material. It was thought that reading few topics would be less tedious than if each item

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[2]The author wishes to express his appreciation to Dr. Dozier W. Thornton for his cooperation in securing this sample from his lecture section.

introduced a new topic or if the topic was the same for all items. Each error scale was represented within every sequence to randomize any practice or fatigue effects. A, E, I, O, and "none of the above" conclusions were given in a multiple-choice format for each item. Answers were recorded on machine scorable answer sheets, and scratch sheets were collected.

The level of difficulty was ascertained in a pilot study for 84 contextual syllogisms,[3] and a pretest and posttest were constructed of 36 items each. The atmosphere error scales consisted of 12 items of EE, EO, II, IO and OO premise pairs so that they would provide an index of atmosphere error susceptibility without confounding conversion errors. That is to say, no predicted atmosphere conclusion could be deduced by an invalid A or O premise conversion. The mean percent predicted response (accounting for correct responses) for the pretest atmosphere scale was 44.4 and 44.3 for the posttest. The 12-item conversion error scales consisted of premise pairs AO figure I and IV and OA figure I and IV. There were three items in each figure. For the AO and OA premise pairs the atmosphere effect should be the weakest, and the A or O invalid conversion operable within the same syllogism. For the conversion error scales on the pretest and posttest, the mean percent predicted response was 39.5 and 40.9, respectively. Items for the determinate scales had valid conclusions given and 71.8 and 74.6 mean percent correct responses for the pre-

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[3]The author would like to thank Dr. Donald M. Johnson for having constructed 36 of these items.

cent correct responses for the pretest and posttest, respectively. Thus, two tests were constructed of roughly equivalent difficulty and consisted of three scales of twelve items to detect any performance change after training. The pretest and the posttest are included in Appendix A.

Procedure

A transfer-of-training paradigm was used to determine the effect of training on syllogistic reasoning performance. The pretest was given in a large lecture session. Tests, scratch sheets, and answer sheets were administered as Ss entered the room and were collected as they left. One week later the training instructions and posttests were administered in the same way and in serial group order to 187 of the Ss in discussion sections which contained from 10 to 25 Ss each. The remainder of the Ss (53) participated within the next two weeks on a voluntary basis and were serially assigned to groups until there were 40 Ss in each. No knowledge of the results were given, and the nature of the experiment was not revealed other than in the most general of terms. Therefore, no transfer of information affecting the results was suspected. For the pretest and the training plus the posttest 45 minutes was ample time for completion.

The coversheet instructions for the pretest and the posttest were identical except for one control group which received one part of the instructions as training material. The nature of the instructions was the same as used in previous experiments. The logical task was discussed specific to the material and format. Verbal instructions also stressed the

necessity of drawing conclusions only from the information in the paragraph. The definition of "some" was given as "at least one," and it was stated that "some are not" does not imply "some are," and vice versa. The use of the alternative "none of the above" was also defined.

All groups other than control Group 6 received training instructions which contained an introductory and concluding paragraph intended to establish rapport and interest. The complete instructions for all groups are included in Appendix B. Group 1 received anti-atmosphere instruction which included a description of the error and an AAA figure II symbolic example. The anti-conversion instructions of Group 2 consisted of a description of the error, the syllogism example of Group 1, and several examples of premises which could (E and I) and could not (A and O) be directly converted. The training instructions for Group 3 were a combination of those of Group 1 and 2. Group 4 received instructions explaining the error of inferring equivalence from an A premise and how to restate A, E, I, and O premises in terms of sets with elements which are shared or not. A premises were described as stating a subset relationship wherein the set denoted by the predicate was assumed to be larger than, and including, the set denoted by the subject. Group 5 was to serve as a control against a Hawthorne effect due to special treatment or motivating instructions. The same introductory and concluding training material was given plus an elaboration of the definition of the term "some." Ss were advised to interpret "some A's and B's" to mean "at least one thing exists which

is both A and B." Thus, "some" was given its traditional meaning of "at least one thing exists which is both A and B." This explanation was excluded from the coversheet instructions for this group. Group 6 served as a control receiving only the coversheet instructions. All groups worked the same syllogisms and had equal time for completion. Since each group was represented every time the posttest was given, testing conditions had no differential effect.

The dependent variables were the number of correct and incorrect answers to each item. A difference score was calculated by subtracting pretest from posttest scores. Since less errors on the posttest would give a negative difference, the constant 25, representing the greatest possible change in either direction, was added to the difference scores. Thus, the change in performance after training was calculated by:

GAIN SCORE = POSTTEST SCORE - PRETEST SCORE + 25.

Following the data collection, the Michigan State University College Qualification Test (CQT) scores were secured for all but one of the subjects. These include scores for reading, vocabulary, arithmatic, and information tests.

RESULTS

The split-half reliability for each test scale was determined by the odd-even method and the Spearman-Brown formula (Guilford, 1965, p. 458). These are given for the pretest and posttest in Table 1. The split-half reliability was estimated to account for varying difficulty over the length of the test. For the pretest the scores for all Ss were used, for the posttest only the untreated Group 6.

Table 1

Split-Half Reliability for each Scale

in the Pretest (N = 240) and Posttest (n = 40)

	Determinate Correct	Atmosphere Error	Atmosphere Correct	Conversion Error	Conversion Correct
Pretest	.61	.65	.76	.73	.68
Posttest	.58	.70	.86	.80	.91

There were 62 males and 178 females in the sample. The point-biserial correlation between sex (female = 1; male = 0) and pretest scores gave one significant value. For the atmosphere error scale the correlation was .172 ($p<.05$). For the biserial correlation between sex and gain scores only in Group 1 were there any significant relationships. A correlation with the atmosphere error scale of -.407 ($p<.01$) and with the atmosphere correct scale of .374 ($<.05$).

The highest other value was .242. The gain scores of females for the number of atmosphere errors and correct were 22.90 and 28.17, respectively. For the males these gain scores were 25.54 and 25. 64, respectively. Thus, any change in performance on atmosphere items in Group 1 was due to the females and such a relationship does not hold for any other group or dependent variable.

The means ($\bar{X}$'s) and standard deviations (S.D.'s) for each scale of the pretest is given in Table 2. There is variation between groups in initial performance, but the summary of the analysis of variance (Winer, 1962, p. 56) for each scale in Table 3 shows no significant differences which would systematically influence the results. Because for each sample n = 40, the population variances were assumed to be homogeneous for each analysis of variance.

Table 2

Means and Standard Deviations for each Treatment Group on each Scale of the Pretest

	Treatment Group					
	1	2	3	4	5	6
Atmosphere error	4.52	5.15	4.60	5.02	5.48	4.75
	2.02	2.04	2.34	2.35	1.91	2.26
Conversion error	5.65	6.78	6.82	6.30	6.75	6.92
	2.50	2.85	2.73	2.34	2.87	2.48
Atmosphere correct	4.02	4.38	4.12	3.88	3.65	4.18
	2.57	2.53	3.21	2.94	2.38	2.51
Conversion correct	1.98	1.38	1.42	1.52	1.12	1.58
	1.90	1.72	2.02	2.44	1.26	1.72
Determinate correct	8.60	8.95	8.95	8.62	9.05	9.42
	1.58	1.78	1.77	2.13	1.63	1.80

Table 3

Summary of the Analysis of Variance

for each Pretest Scale Between all Groups

Source	df	Atmos. error		Conv. error		Atmos. correct		Conv. correct		Deter. correct	
		MS	F	MS	F	MS	F	MS	F	MS	F
Between groups	5	5.20	1.11	9.40	1.36	2.60	.36	3.20	.91	3.80	1.19
Within groups	234	4.67		6.96		7.32		3.53		3.20	

Hypothesis I

Several studies have consistently shown the same prevalent errors in syllogistic reasoning with familiar verbal and symbolic materials. Thus, it was expected that the same erroneous alternatives would be chosen in a test of contextual material. The preferred errors for EE, EO, II, IO, and OO premise pairs were expected to be those predicted by the atmosphere hypotheses and for AO premise pairs to be those predicted by the conversion hypotheses. The percent of the responses to each item on the atmosphere and conversion error scales is given for the pretest (N = 240) in Table 4 and for the posttest of Group 6 (n = 40) in Table 5. Blank responses made some totals less than 100%. The mean percent error on the pretest for the atmosphere and conversion items is 66.4 and 87.6, respectively, and for the posttest 57.6 and 82.1, respectively.

For the conversion error items on the pretest and posttest the number of predicted errors exceeded any other single

error alternative on a total of 23 out of 24 items. The Pearson chi square (Hayes, 1963, p. 582) of errors on each item was statistically significant ($p < .001$). On the pretest 62.1% of the errors were predicted, and 77.8% were predicted on the posttest. Random responding on the four error alternatives would have resulted in 25% of the errors being predicted. To statisically describe the predictability of this hypothesis the errors for the twelve items on the pretest and the posttest were classified as not-predicted or predicted, and a chi square was calculated with one degree of freedom to test the theoretical population ratio of 3 : 1. Since more than half of the errors were predicted, it is not surprising that the obtained ratio differed from the theoretical ratio at a statistically significant point ($p < .0001$).

On the atmosphere error items of the pretest and posttest the predicted error was favored on a total of 18 out of 24 items. On all but one item the obtained distribution deviated from a random distribution at a statistically significant point ($p < .0001$) as indicated by chi square. The remaining item was statistically significant at the .05 level. On the pretest 62.0% of the errors were predicted by the atmosphere hypotheses, and on the posttest 64.8% were predicted. As with the conversion hypotheses, the obtained ratio of not-predicted to predicted errors differed from 3 : 1 ($p < .0001$) for the pretest and the posttest as indicated by chi square.

On the basis of this evidence Hypothesis I cannot be rejected.

Table 4

Percentage of Ss choosing each Alternative on the

Atmosphere and Conversion Error Items for the Pretest

Atmosphere Error Items								Conversion Error Items							
Item No.	Premises	Figure	A	E	I	O	None	Item No.	Premises	Figure	A	E	I	O	None
1	EE	II	2	31*	8	6	53	3	AO	I	3	13	22	47*	15
2	IO	II	3	32	29	22*	14	4	OA	IV	1	7	35	45*	12
8	II	IV		4	58*	9	28	10	AO	I		3	20	68*	8
11	IO	II		3	14	66*	16	12	AO	IV	1	1	29	54*	15
13	EE	II	6	27*	6	2	59	17	OA	IV	1	3	31	53*	12
15	IO	II		8	18	37*	37	18	OA	I	1	3	14	70*	11
22	II	II	5	10	22*	3	59	20	OA	I	1	3	17	72*	8
23	EO	II	3	19	37	16*	25	21	OA	IV	8	5	20	42*	25
28	II	I	1	3	62*	7	26	26	AO	I	1	5	14	75*	5
30	IO	IV	1	6	18	48*	28	29	AO	IV	3	3	13	62*	19
33	EE	I	6	51*	5	2	36	31	AO	IV	3	5	15	64*	13
34	IO	I	1	4	18	54*	22	36	OA	I	17	2	69	5*	8

* Error predicted by respective hypotheses

Table 5

Percentage of Ss choosing each Alternative on the

Atmosphere and Conversion Error Items for the Posttest

Atmosphere error items								Conversion error items							
Item No.	Premises	Figure	A	E	I	O	None	Item No.	Premises	Figure	A	E	I	O	None
2	II	I		2	55*	3	40	4	OA	IV		25	20	45*	10
3	OE	II	5	22	15	33*	25	6	AO	I	2		2	88*	8
10	OI	II	2	5	35	21*	37	7	AO	IV			15	55*	30
12	EO	II		32	9	13*	45	9	OA	IV			20	53*	27
13	II	II		5	30*	5	60	15	AO	I		5	2	73*	20
18	II	II			40*	2	58	17	AO	IV	2	3	10	55*	30
23	II	IV			63*		37	19	OA	IV		10	23	55*	13
24	IO	II		2	8	53*	37	21	OA	I		8	10	75*	7
27	IO	II	2	5	15	45*	33	25	OA	I			7	75*	18
29	EE	I	30	25*	2		43	26	AO	I	5	5	12	50*	28
33	II	II			55*	5	40	31	OA	I	2	5	5	80*	8
35	OO	II	2	5	20	18*	55	34	AO	IV	2	2	13	60*	23

*Error predicted by respective hypotheses

Hypothesis II

If the performance on one error were independent of performance on the other error, there would be no covariance between the two variables. This would be true if the correlation between atmosphere and conversion items for the error scores and for the number correct was not statistically different from zero. For the pretest and the posttest of Group 6 the distributions for the atmosphere and conversion error scores were approximately normal. The product-moment correlation between the atmosphere and conversion error scores for the pretest was .382, and for the posttest was .347 as shown in Tables 6 and 7. A two-tailed test showed the pretest correlation to differ from zero beyond the .01 level (df = 238), and for the posttest the correlation differed from zero at the .05 level of confidence (df = 38).

The correlation between the true scores on these tests would be expected to be higher if the errors of measurement did not attenuate the degree of correlation; i.e., if the tests were perfectly reliable (see Table 1 for the test reliabilities). To find a truer estimate of the above correlations, a correction for attenuation (Guilford, 1965, p. 486) was executed, and the true pretest correlation was estimated at .556 and the true posttest correlation at .463.

To account for any variance due to factors other than reasoning ability itself the reading and numerical components were partialed out of the total variance by the method of partial correlation (Guilford, 1965, p. 340). Guilford, Kettner, and Christensen (1955) found verbal comprehension

and numerical facility and achievement to be factors correlated with a general reasoning ability, and intuitively reading comprehension would play a larger part in performance on reasoning tests with complex paragraphs than in performance on symbolic syllogisms. The CQT scores were secured for each S, and the reading comprehension (R) and numerical (N) scores were used to eliminate the effects that these variables had upon the atmosphere-conversion error correlation. The partial correlation for the pretest between the atmosphere and conversion errors with the effects of reading comprehension eliminated is .390 and with the effects of numerical ability eliminated it is .392. That correlation with both effects partialled out was .399 which remained statistically significant beyond the .01 level by a two-tailed test. Partialling out the influence of reading comprehension in the posttest the atmosphere-conversion error correlation became .334. With the influence of numerical ability removed the correlation was .329 which remained statistically significant at the .05 level by a two-tailed test.

Since error scores bear such a strong negative correlation to their respective correct scores, one would expect that the number correct would have a covariance at least as large as the error scores. Were this true it would also be evidence against the independence of the errors. The distributions for the number correct on the pretest and posttest scales were not skewed beyond a value of 1.527 when zero was normal. From Table 6 the pretest atmosphere-conversion correct product-moment correlation was .505. From Table 7 that correlation

Table 6

Product-Moment Correlations Between the Pretest Scales and CQT Scores for Reading and Numerical Tests (n = 240)

Scales	1.	2.	3.	4.	5.	6.	7.
1. Atmosphere error	1.000						
2. Conversion error	.382	1.000					
3. Atmosphere correct	-.674	-.005	1.000				
4. Conversion correct	-.315	-.370	.505	1.000			
5. Determinate correct	.031	.367	.255	.075	1.000		
6. Determinate "none"	-.207	-.199	.165	.139	-.572	1.000	
7. CQT R	-.080	.072	.245	.193	.277	-.150	1.000
8. CQT N	-.035	.151	.243	.192	.278	-.154	.420

for the posttest was .589. A tendency to respond to "none of the above" regardless of content could have made this correlation spuriously high. A partial correlation removing the covariance due to responding to "none of the above" between the correct responses of atmosphere and conversion items on the pretest of .493 and on the posttest of .579 indicated that such an influence was small. Any covariance contributed by a common ability such as reading comprehension or numerical ability would show itself more in correct reasoning than incorrect reasoning. Thus, the partial correlations were calculated removing the variance due to reading comprehension (CQT R), numerical ability (CQT N), and a tendency to respond with "none of the above." For the pretest this partial corre-

Table 7

Product-Moment Correlations

Between the Posttest Scales of Group 6

and CQT Scores for Reading and Numerical Tests (n = 40)

Scale	1.	2.	3.	4.	5.	6.	7.
1. Atmosphere error	1.000						
2. Conversion error	.347	1.000					
3. Atmosphere correct	-.864	-.224	1.000				
4. Conversion correct	-.510	-.758	.589	1.000			
5. Determinate correct	.134	.134	.072	-.070	1.000		
6. Determinate "none"	-.293	-.304	.141	.194	-.580	1.000	
7. CQT R	-.225	-.109	.327	.393	.038	-.161	1.000
8. CQT N	-.247	-.092	.398	.322	.142	-.005	.297

lation between number correct on the atmosphere and conversion items was .447. For the posttest it was .466. Statistically both correlations remained significant beyond the .01 level by a two-tailed test.

On the basis of this evidence Hypothesis II must be rejected. Note also in Tables 6 and 7 that the correlation between atmosphere errors and conversion correct is high and negative in both the pretest and posttest. The converse relationship, i.e., between atmosphere correct and conversion error, is small and not statistically deviant from zero.

Hypothesis III

It was expected that anti-error training instructions would reduce the errors against which the instructions were directed and not others. Similiarly it was expected that the only increase in the number of correct on error items would be for the group trained against that specific error. Thus, the hypothesis tested statistically was that the mean number of errors (or number correct) was equivalent for each group on each dependent variable. A gain score was calculated by subtracting the pretest score from the posttest score and adding 25, the greatest possible change. Thus, an error (or number correct) gain score of less than 25 would represent a decrease in errors (or number correct). A gain score of more than 25 would represent an increase in errors(or correct responses).

Table 8 shows the mean gain score and the standard deviation for Groups 1-6 with 40 Ss per group. Note the highest mean for number correct was 27.48 which represented an average increase in the number of correct responses of 2.48. The lowest mean for the number of errors was 23.62 which represented an average decrease in errors of 1.38. The reliability and standard error of measurement (Thorndike and Hagen, 1961, p. 367) for each scale is shown in Table 9. These were lower than for the pretest and posttest separately because of the correlation between the tests which ranged from .306 to .519 for all groups ($n = 240$). Because the number of Ss in each group was large and equal, homogenity of variance was assumed, and a one-way

Mean Gain Scores and Standard Deviations

for Groups 1-6 on each Scale

Scale	Group					
	1	2	3	4	5	6
Atmosphere error	23.62 2.94	23.95 2.58	24.25 3.10	24.48 2.87	23.82 2.24	24.72 2.88
Conversion error	25.65 2.85	25.65 3.21	24.32 3.06	25.78 2.55	26.02 2.72	25.70 2.62
Atmosphere correct	27.48 3.06	26.38 3,83	26.80 3.62	25.90 2.86	27.10 2.23	25.92 3.47
Conversion correct	26.30 2.88	26.18 2.26	26.55 3.00	25.45 2.01	25.68 1.42	25.62 1.81
Determinate correct	24.90 2.57	25.60 2.07	24.92 2.34	25.90 2.18	25.75 1.58	25.65 1.94

analysis of variance was used to test the equality of mean gain scores for all groups on each separate dependent variable. Table 10 summarizes the analysis for each dependent variable. The differentiation between means on the conversion error was the only difference which approached significance. Dunnet's t-statistic (Winer, 1962, p. 89) was used for a post-mortem comparison of the mean gain score of each experimental group with that of the control Group 6 across each independent variable. Only on the atmosphere correct scale was there any difference which was statistically significant; Group 1 made more correct responses on atmosphere items than the untrained Group 6, and other groups did not differ from the control ($t = 2.29$, $p < .05$). Worthy of note among these results was that Group 4 with only training in the definition of "some"

did well albeit not significantly better than the control Group 6. Also Group 3 did not perform better than either Group 1 or 2, even though that training incorporated the instructions of both Group 1 and 2.

The equivalence hypothesis was proposed to account for the errors made in the solution of syllogisms which Chapman and Chapman (1959) explain by an invalid A premise conversion. In the present materials these syllogisms were AO figure I and OA figure I. If the training instructions did reduce the number of errors made on these items the relative gain would be larger than that for Group 6. On these items 37 more errors were made on the posttest than on the pretest for Group 4, and Group 6 had 31 more errors. No significance test was necessary to see that such training instructions did not affect that type of error.

Table 9

Gain Score Reliability and Standard Error of Measurement for each Scale

	Atmos. Error	Conv. Error	Atmos. Correct	Conv. Correct	Deter. Correct
Reliability	.505	.580	.416	.574	.367
Standard Error	3.43	3.83	6.66	3.23	2.65

Table 10

Summary of the Analysis of Variance for Gain Scores Between all Groups on each Dependent Variable

Source	df	Atmos. error		Conv. error		Atmos. correct		Conv. correct		Deter. correct	
		MS	F	MS	F	MS	F	MS	F	MS	F
Between groups	5	7.00	.90	16.20	2.01	16.40	1.76	7.80	1.47	7.40	1.62
Within groups	234	7.74		8.09		9.28		5.29		4.57	

DISCUSSION

Hypothesis I

On the atmosphere and conversion items the largest number of errors will be predicted by the atmosphere and conversion hypotheses, respectively.

The obtained percentage of errors predicted by the respective hypotheses with contextual material is comparable to that obtained in other studies incorporating other material. For contextual material 62 & 65% of the errors on atmosphere items were predicted by the atmosphere hypotheses, and 62 & 78% of the errors on conversion items were predicted by the conversion hypotheses. For symbolic syllogisms of the same mood the atmosphere items in the studies of Simpson and Johnson (1966), Chapman and Chapman (1959) and Morgan and Morton (1944) report the percent of the errors predicted by the atmosphere hypotheses to be about 70%, 67% and 67%, respectively. On the conversion items they found the percent of the errors predicted by the conversion hypotheses to be about 60%, 78% and 73% respectively. Morgan and Morton (1944) found that for familiar verbal material about 60% and 67% of the errors were predicted by the atmosphere and conversion hypotheses, respectively. The direct implication of this is that the errors found in syllogistic reasoning with contextual material correspond with those found in symbolic and verbal material in both kind and amount.

Looking beyond the statistical description, these data do not agree with the data of Chapman and Chapman (1959) on those items on which the atmosphere error fails to predict the favored response. Specifically this occurs at least once with each premise pair used except II. In view of the overall predictability of these errors, this may be interpreted as the influence of content upon reasoning. In other words, people reason with the information available. If the syllogisms are symbolic, the available information is less than if they were of familiar verbal material, and reasoning may be based on information about the structure of the syllogism, i.e., quantifiers and qualifiers. Thus, the extent to which the supposedly meaningless context makes meaningful information about the terms available to the subject, the more the conclusion will be based on that information and less on the logical structure. Thus, if errors are made, they would not necessarily be those predicted. This corresponds with the results of Wilkins (1928) and Morgan and Morton (1944) where it was found that less errors occurred on familiar verbal than symbolic material, and the most difficult syllogisms were those where the correct conclusion was contrary to belief. When knowledge about the terms of verbal syllogisms either is not available (unfamiliar terms), or is not relevant (e.g., "all insults are troubles"), they are slightly more difficult than symbolic syllogisms according to the data of Wilkins (1928) and Morgan and Morton (1944). Thus, for those items on which the predicted errors are not favored, it could

be that the information available led the subject to other conclusions.

Hypothesis II

Performance on the atmosphere error items will not be dependent upon performance on the conversion error items.

On the basis of this evidence this hypothesis must be rejected. Rather than being uncorrelated, there is a substantial correlation between performance on the conversion and atmosphere items on both number of errors and number of correct responses. By partial correlations this was shown not to be due to any variance shared with reading comprehension, numerical ability, or tendency to respond to "none of the above" on all items. Aside from the statistically significant difference from a value of zero, the amount of variance shared does not exceed 36% This, however, is an impressive amount when it is considered that the items were designed to be as independent as possible. For the AO conversion items invalid conversions of both A and O premises were possible which implied that these items would be the most susceptible to invalid conversions. Although the O conclusion was predicted for the conversion items by the atmosphere hypotheses, it was suspected that the atmosphere effect would be quantitatively weakest with AO premises. The predicted errors on atmosphere items could not be deduced by invalid A or O conversions since there were no A premises and no O-conversion would yield the predicted conclusion for any syllogism. The obtained correlations would have been

larger if the error scales had been perfectly reliable or if AE and AI premises were used as conversion items. In addition, the obtained dependence was replicated in the posttest albeit with the same subjects.

One aspect of the correlational relationship between performance on the error items which cannot be readily explained is the high negative relationship between the number of atmosphere errors and the number of conversion correct. This was replicated on the posttest, but the converse relationship, between the number of conversion errors and the number of atmosphere correct, does not obtain either on the pretest or the posttest. This relationship between the number of atmosphere errors and the number of conversion correct corresponds in direction and magnitude to the negative relationship between the number of atmosphere errors and the number of atmosphere correct. This is interesting, but inexplicable, at the moment. Perhaps if a test of syllogistic reasoning which contained several of all possible indeterminate syllogisms were factor analyzed, only one factor would emerge rather than the proposed atmosphere and conversion error factors. Such an analysis would account for all correlations.

The obtained dependence, of course, is contradictory to the -.12 correlation between the number of atmosphere and conversion errors reported by Simpson and Johnson (1966). This may be resolved, however, by examining their scoring procedure for atmosphere items. For the IO and EO premise pairs conclusions of I or O and of E or O, respectively, were scored as predicted atmosphere errors. Although this

scoring is consistent with the results of Chapman and Chapman (1959), it is inconsistent with the predictions of the secondary atmosphere hypotheses which state that a particular premise creates a "some" atmosphere, eventhough the other may be universal, and that a negative premise creates a negative atmosphere, eventhough the other may be affirmative (Woodworth and Sells, 1935, p. 453). Thus, the original atmosphere hypothesis would predict only an O conclusion for the EO and IO premise pairs. Since there were four EO and IO items, 16 responses were scored as conversion errors. This would be conducive to a low negative correlation as obtained. The difficulty of the conversion items was augmented by the presentation of eight items of OA figure IV form in AO figure I order which necessitated S manipulating premise order prior to actually reasoning. This was not true for the atmosphere items. This would have enhanced the difference as a random variability in conversion item performance.

The hypothesis of Chapman and Chapman (1959) would also predict independence of performance, because the items were designed so that invalid A or O conversions would not yield a predicted error on the atmosphere items. On the other hand, the atmosphere hypotheses do predict the conversion error responses (AOO). The operation of one invalid reasoning process or mechanism is possible considering the degree of dependence between the error scales. It may, therefore, be concluded on the basis of this evidence that for this contextual material and for this sample of subjects the conversion hypotheses are untenable. Because of these restrictions

the generality of this conclusion is open to question. Further evidence could be obtained from retesting with symbolic syllogisms or differential training.

Hypothesis III

For groups receiving specific training instructions against the atmosphere, conversion, or equivalence error, a decrease in errors or an increase in correct conclusions will obtain only on error items against which the training instructions were directed.

The analysis of variance tested the hypothesis that the means of all groups were equal, and the hypothesis could not be rejected for any dependent variable. This indicates that no group improved more than any other. Thus, Hypothesis III must be rejected in view of the present data.

The implications of such a rejection are less meaningful than had it been rejected only for some variables. Post-mortem t-tests showed there was only one gain in any group which differed significantly from the control group which had no training. Since the largest gain in performance was +2.5, the most attractive explanation is that the failure to differentiate between groups was due to the low gains by all groups. The effect of low gains would have been augmented by the large within group variance which is usually the case with training studies.

Explanations for low gains are many, and almost any could be true in this case. Perhaps effective training was not possible due to the abstractness of the material or the non-

existence of the proposed atmosphere and conversion error mechanisms. Because Simpson and Johnson (1966) were able to reduce atmosphere errors and increase the number of correct atmosphere responses, this possibility may be tentatively eliminated for the atmosphere error.

Another alternative would suggest that the instructions were not learned because Ss were not attentive to them. Although there can be no direct evidence for this, anyone who has given tests to undergraduates can vouch for their reluctance to read or observe intructions. In this case the instructions were often longer than two double-spaced pages, and everyone had taken a similiar test previously.

Other studies which have trained against errors in reasoning have reported appreciable success with various procedures. Simpson and Johnson (1966) used a 15-minute lecture plus numerous examples and practice to reduce atmosphere errors. Their failure to substantially reduce conversion errors may be due to the fact that they trained against an A-conversion and included nine items which needed an O-conversion (OA figure IV). In fact two conversion items were determinate (OA figure III) with the predicted error actually being a valid inference. Henle and Michael (1956) reduced the number of invalid conclusions by oral instructions on how to solve syllogisms by using diagrams, and examples were given. Moore and Andersen (1954) trained Ss in the solution of logic problems in a sentential calculus with an 80 minute lecture, examples, and a series of visual aids. Wason (1964) used self-discovery

to reduce errors in syllogisms by allowing a valid inference to contradict a previously drawn invalid inference. Apparently improvement is possible with a more substantial training procedure than was used in this experiment. Recommended improvements would be the use of (1) oral instructions with a question and answer period, (2) summary instructions which would be available to each S, and (3) practice on syllogisms not to be used later. Care must be taken, however, to make training specific to one error, not to identify the syllogisms to be used later, and to maximize transfer between the instructions and practice and the problem solving task (Duncan, 1959). Were such improvements made, it would be expected from the present evidence that the anti-atmosphere error training would reduce atmosphere and conversion errors, and that the anti-conversion error training would, either not effectively reduce conversion errors, or would not do so differentially.

SUMMARY

Several previous studies have shown that Ss untrained in the use of formal logic accept very predictable erroneous conclusions when solving syllogism problems. Two types of logical operations have been proposed to account for such consistent behavior. The atmosphere effect (Woodworth and Sells, 1935; Sells, 1936) was defined as the influence which the context, or tone, of a situation has upon the completion of a task. It was assumed that, if S does not understand, or does not use, the given logical relationships, the conclusion will be based upon the structural features of the syllogism, i.e., the quantifiers and qualifiers. Thus, for like premises a like conclusion would be predicted. For unlike premises one negative premise would predict a negative conclusion, and one particular premise would predict a particular conclusion.

The conversion hypotheses (Chapman and Chapman, 1959) assume that the logical relationships are understood, with the exception that an A or O premise may be invalidly converted. Thus, after making an invalid conversion, a conclusion will be deduced by otherwise valid operations. This was proposed as an alternative explanation to the atmosphere hypotheses for certain items. The predicted responses are the same for those items.

Because these contradictory hypotheses predicted erroneous conclusions equally well for certain syllogisms, Simpson and Johnson (1966) trained against each error separately. On items where only the atmosphere hypotheses predicted the favored conclusion, the groups receiving anti-atmosphere error training produced the least number of errors and the greatest number of correct responses. On the conversion error items the anti-conversion error training did not influence performance any more than other training procedures. For untrained Ss the correlation between the number of atmosphere and conversion errors was only -.12. Several methodological faults in this experiment, however, indicated the necessity of replication.

The present experiment used a transfer-of-training paradigm to detect changes in performance due to differential training. The premises of the syllogisms were of neutral emotional content and used unfamiliar, or nonsense, words for terms. These were included in a paragraph to approximate complex reading material. The pretest and posttest included 12 atmosphere error, 12 conversion error, and 12 determinate items. Ss were assigned randomly to six groups of 40 Ss each. These groups received written instructions against the atmosphere, conversion, or equivalence errors. One group received both anti-atmosphere and anti-conversion error instructions. A control group received the introductory paragraph and the definition of "some" which the training groups had received. The other control group received no training instructions.

The results indicated that the errors made on syllogisms of contextual material were similiar in kind and amount to those made on syllogisms of symbolic or verbal material. A correlational analysis of the relationships between performance on error items indicated a substantial dependence. Both the number of errors and the number of correct responses for the error items were correlated at a statistically significant level, i.e., between .347 and .589. This was not predicted from past research and had particular import since only the atmosphere hypotheses could predict the errors for both types of item. On the atmosphere items no predicted error could result from an invalid A or O premise conversion. Partial correlations showed that these correlations were not due to a covariance with reading comprehension, numerical ability or tendency to respond "none of the above" to all items. These results were interpreted as evidence against the proposed conversion error. Other evidence, however, is necessary to strengthen the generality of this conclusion. Differential training would have supplied further evidence, but no type of training instructions produced a significant change in performance. Possible causes of this and improvements in this procedure were discussed. Future research in this area was also suggested.

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APPENDIX A

LOGICAL ABILITIES TEST

Remove the answer sheet from the test booklet and place (1) your name, (2) your student number, and (3) the name of the test in the appropriate places. Place a "Yes" or a "No" in the place marked "Instructor" answering whether or not you have previously had a class dealing with formal logic.

Within this test you will find paragraphs each followed by five statements. Your task is to read each paragraph carefully, then, if a conclusion is deducible from the statements in the paragraph, select that conclusion from those given and mark that number on your answer sheet. If no conclusion is logical from the statements in the paragraph, mark option "5" on your answer sheet.

To avoid confusion the definition of the term "some" is to be "there exists at least one...." This is to say that you may not infer "some A are not B" from the statement "some A are B." Similarly, "some A are not B" does not imply "some A are B."

Work as fast as you can, but there should be ample time for you to finish. Be sure to answer every question, even if you have to guess.

Place no marks on this test booklet. There will be scratch paper provided.

DO NOT BEGIN UNTIL TOLD TO DO SO.

LOGICAL ABILITIES TEST

1. There are many species of plants in South America with beautiful flowers that are practically unknown in Europe and North America. Visitors to South America are always fascinated by the colorful Hofmeisters, named after the German explorer who first described them, and the shy shade-loving Helgas, named after his wife. Hofmeister is best known for his cultivation of the Stersidas, however. None of the Hofmeisters are Stersidas, to be sure, and none of the Thorntis are Stersidas, but North Americans like to photograph all of them.

   What can be inferred from this paragraph?

   (1) All Thorntis are Hofmeisters.
   (2) No Thorntis are Hofmeisters.
   (3) Some Thorntis are Hofmeisters.
   (4) Some Thorntis are not Hofmeisters.
   (5) None of the above.

2. The Brazilian Aloutte has a small flower and an unpleasant scent, but some of them have edible roots and are sold commercially as Picaros. The Pobrecias which one sees in the markets also have an unpleasant scent, but none of the smaller Pobrecias that grow high up on mountains are Picaros.

   Therefore:

   (1) All Pobrecias are Alouettes.
   (2) No Pobrecias are Alouettes.
   (3) Some Pobrecias are Alouettes.
   (4) Some Pobrecias are not Alouettes.
   (5) None of the above.

3. The delicate Glorias of Argentina, which open only in cool weather, are all Sassoids. Some of the equally delicate Fragilas, found only in damp areas, are not Glorias.

   What can you infer from these statements?

   (1) All Fragilas are Sassoids.
   (2) No Fragilas are Sassoids.
   (3) Some Fragilas are Sassoids.
   (4) Some Fragilas are not Sassoids.
   (5) None of the above.

4. If you hike along the mountain streams of Equador, you may be lucky enough to see the large red Fiegantas, some of which are not true Corads. All Corads, we now know, are Vemordas.

   Therefore:

   (1) All Vemordas are Fiegantas.
   (2) No Vemordas are Fiegantas.
   (3) Some Vemordas are Fiegantas.
   (4) Some Vemordas are not Fiegantas.
   (5) None of the above.

(over)

5. In Spring in Chile everyone goes to the fields to pick the huge golden Cunlas, all of which are Platyphores. Some Monarchs are Cunlas which can be steeped to make a weak tea.

Therefore:
(1) All Monarchs are Platyphores.
(2) **No Monarchs are Platyphores.**
(3) Some Monarchs are Platyphores.
(4) Some Monarchs are not Platyphores.
(5) None of the above.

6. In the district of Gruanda in Brazil there is only one tribe remaining which is virtually untouched by civiliaation as we know it. We shall call them Gruandans for simplicity. Reliable sources indicate that no fisherman on the Amazon is a Christian. All of the Gruandans are fisherman who depend on the mighty Amazon for sustenance.

From these statements you may conclude:
(1) All Gruandans are Christians.
(2) **No Gruandans are Christians.**
(3) Some Gruandans are Christians.
(4) Some Gruandans are not Christians.
(5) None of the above.

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7. One of the earliest civilizations that we have dependable knowledge of developed in the fertile valley between the Menoh River, as it was then called, and the Eurak River. For many years historians believed that the Menoh people and the Euraki had had little contact But tablets recently discovered from the Menoh River have established the custom of dual citizenship. These tablets demonstrated that the Euraki feared the river, apparently for religious reasons. Thus, none of the Euraki were sailors. Also the tablets indicated that some Menoh were actually Euraki.

Therefore:
(1) All Menohs were sailors.
(2) **No Menohs were sailors.**
(3) Some Menohs were sailors.
(4) Some Menohs were not sailors.
(5) None of the above.

8. Tales that come to us from the classical storytellers frequently mention the Demeks, the Eosirs, and the Fellutos of the middle kingdom. The glory of the middle kingdom, only hinted at in the ruins that survive, was due chiefly to the warlike Demeks, some of whom were Eosirs. The Felluto tradesmen and sailors carried these tales throughout the Mediterranean and, because some of the Eosirs were Fellutos, many of the tales have survived to this day.

Therefore:
(1) All Fellutos were Demeks.
(2) **No Fellutos were Demeks.**
(3) Some Fellutos were Demeks.
(4) Some Feluttos were not Demeks.
(5) None of the above.

9. The Lyd people of this period inhabited the arid coastal plains. Wood was absent, of course, from these regions and no fishermen in this area were boatmen. To supplement the frequently low crop yield some Lyds labored as fishermen.

It follows that:

(1) All Lyds were boatmen.
(2) No Lyds were boatmen.
(3) Some Lyds were boatmen.
(4) Some Lyds were not boatmen.
(5) None of the above.

10. The limestone monuments of the early kingdom, crude as they are, show us some of the forms of worship of the Rizehs, all of whom wore leafy ornaments on the head and were therefore called Leafmen. The Kephru clan, some of whom were not Rizehs, apparently did not erect monuments. At least none survived.

Therefore:

(1) All Kephrus were Leafmen.
(2) No Kephrus were Leafmen.
(3) Some Kephrus were Leafmen.
(4) Some Kephrus were not Leafmen.
(5) None of the above.

11. The Kephrus worship the spirits of the weather. Some phantoms who rule the wind and sky are Ives. Kephrus also believe that some spirits of drought are not Ives.

From these statements you may conclude:

(1) All spirits of drought are phantoms who rule the wind and sky.
(2) No spirits of drought are phantoms who rule the wind and sky.
(3) Some spirits of drought are phantoms who rule the wind and sky.
(4) Some spirits of drought are not phantoms who rule the wind and sky.
(5) None of the above.

12. In the mythical land of Id there dwells the Pygian tribe. These uncivilized natives came from the highlands of Adda, so all of them are Addans. However, some Addans are not relatives of neighboring Bydans.

Therefore:

(1) All relatives of the Bydans are Pygians.
(2) No relatives of the Bydans are Pygians.
(3) Some relatives of the Bydans are Pygians.
(4) Some relatives of the Bydans are not Pygians.
(5) None of the above.

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13. In investigating the collapse of rabbits' ears Dr. Thomas found that the body of a rabbit naturally releases trypsins, none of which are papins, Confusing to the detection of certain enzymes are those called ficins. No ficins are papins, because of almost indetectable structural dissimilarities.

Therefore:

(1) All ficins are trypsins.
(2) No ficins are trypsins.
(3) Some ficins are trypsins.
(4) Some ficins are not trypsins.
(5) None of the above.

(over)

14. It has long been known that man's digestion, like that of the other mammals, depends on a complex series of chemical reactions in the stomach and small intestine. Scientists at the Federal Institute have analyzed certain steps in the digestive process and have proven that the glyphase, which is produced first in the stomach under ordinary conditions, is bectone. This bectone, a clear tasteless liquid, is the familiar dorol, originally synthesized by Professor Dorough, after whom it is named.

What can you infer from this paragraph?
(1) All glypahse is dorol.
(2) No glypahse is dorol.
(3) Some glyphase is dorol.
(4) Some glyphase is not dorol.
(5) None of the above.

15. Precise measurements of the gases generated in the stomach have disclosed the origins of the lornygen which makes infants uncomfortable after eating. Some of the acid-forming cholibase is lornygen. And some of the respibase, which appears before feeding, is not lornygen, and seems to disappear without discomfort.

Therefore:
(1) All respibase is cholibase.
(2) No respibase is cholibase.
(3) Some respibase is cholibase.
(4) Some respibase is not cholibase.
(5) None of theabove.

16. Plaskol is a complex substance of high concentration that absorbs large amounts of water. All plaskol is solutin. Some of the epidol found in the intestinal walls, is plaskol.

Therefore:
(1) All solutin is epidol.
(2) No solutin is epidol.
(3) Some solutin is epidol.
(4) Some solutin is not epidol.
(5) None of the above.

17. Three chemical substances of particular importance to human digestion are turgide, hoximide, and cytol. Some turgide is not hoximide. All hoximide, however, is cytol.

Therefore:
(1) All cytol is turgide.
(2) No cytol is turgide.
(3) Some cytol is turgide.
(4) Some cytol is not turgide.
(5) None of the above.

18. In the final stage, many of the complex chemical substances are eliminated, but the dextrocubes remain. Some dextrocubes are not aminates, which are highly injurious to the digestive organs. The leptpcubes also remain, all of which are dextrocubes.

(1) All leptocubes are aminates.
(2) **No leptocubes are aminates.**
(3) Some leptocubes are aminates.
(4) Some leptocubes are not aminates.
(5) None of the above.

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19. In the automated army of the future, the ranks and assignments will be highly specialized around technical skills and accomplishments. No Popguards will be Shootmen, because of the special training required. All Citmen, however, will be Popguards with regular duties and privileges.

Therefore:
(1). All Citmen will be Shootmen.
(2) **No Citmen will be Shootmen.**
(3) Some Citmen will be Shootmen.
(4) Some Citmen will not be Shootmen.
(5) None of the above.

20. In this automated army of the future, some Corpgals will not be Teengals, depending on the results of medical and psychological tests. All Groundgals will be Corpgals.

Therefore:
(1) All Groundgals will be Teengals.
(2) **No Groundgals will be Teengals.**
(3) Some Groundgals will be Teengals.
(4) Some Groundgals will not be Teengals.
(5) NOne of the above.

21. The elite heros of this army, the Astromen, will need years of specialized training and some Cellmen will not become Astromen. All Astromen, of course, will be Gomen.

Therefore:
(1) All Gomen will be Cellmen.
(2) **No Gomen will be Cellmen.**
(3) Some Gomen will be Cellmen.
(4) Some Gomen will not be Cellmen.
(5) None of the above.

22. At the top of the command structure of the future army will be the Omnimen, who have come up from the ranks of the Starmen and Wingmen. Thus, some Starmen will be Omnimen and some Wingmen will be Omnimen.

Therefore:
(1) All Wingmen will be Starmen.
(2) **No Wingmen will be Starmen.**
(3) Some Wingmen will be Starmen.
(4) Some Wingmen will not be Starmen.
(5) None of the above.

(over)

23. The Flygirls in the future army will be recruited from school, but will stay in school for preliminary indoctrination. None of the other girls, called Dropgirls, will be Flygirls. A volunteer group will be trained for special duties after aptitude tests, and some Ingirls will not be Flygirls.

You may conclude from these statements:
(1) All Ingirls will be Dropgirls.
(2) No Ingirls will be Dropgirls.
(3) Some Ingirls will be Dropgirls.
(4) Some Ingirls will not be Dropgirls.
(5) None of the above.

24. The forward ranger unit of the future army will include Redmen, Whitemen, and Bluemen, chosen for their physical skill and personality. No Whitemen will be Bluemen. But some Redmen will be Whitemen in this unit and have the same duties and equipment.

Therefore:
(1) All Redmen will be Bluemen.
(2) No Redmen will be Bluemen.
(3) Some Redmen will be Bluemen.
(4) Some Redmen willnot be Bluemen.
(5) None of the above.

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25. Although psychologists today seldom speak of personality types, the typologies of the 19th century attracted considerable attention among educated people, at least at the conversational level. According to the system of Professor Heinroth, Liebogynes are friendly individuals and Rechtgynes are honest individuals. Hence, some Liebogynes are Rechtgynes. The good old professor also said that no Rechtgynes could be Unigynes.

Therefore:
(1) All Liebogynes are Unigynes.
(2) No Liebogynes are Unigynes.
(3) Some Liebogynes are Unigynes.
(4) Some Liebogynes are not Unigynes.
(5) None of the above.

26. An entertaining book published by the Earl of Cobb, which was popular in Britain in the last century, designates philoprogenitive people as Philos. Those with a career of premsia are called Prems, and all Prems are Philos. The Earl himself was a Xanthi and, according to this system, some Xanthi are not Prems, regardless of what others said at the time.

Therefore, according to this system:
(1) All Xanthi are Philos.
(2) No Xanthi are Philos.
(3) Some Xanthi are Philos.
(4) Some Xanthi are not Philos.
(5) None of the above.

27. American psychology and psychiatry of this period had an influence on the literature of the time. Dr. Young's Dextroverts appeared in plays and novels, and it was well known, because of his popular lectures, that all Dextroverts are Retroverts, and that some slocatic people are Dextroverts.

According to Dr. Young, therefore:
(1) All slocatic people are Retroverts.
(2) No slocatic people are Retroverts.
(3) Some slocatic people are Retroverts.
(4) Some slocatic people are not Retroverts.
(5) None of the above.

28. The McLaughlin International School of Personality, which developed around the turn of the century, tied personality types to foods. Corn-growing people, with an agricultural type of character and home life, were called Stalks, and fish-eating people, with a fisherman's personality, were called Lines. Some Stalks were Lines, however, for one reason or another. The Hunts, who pursued their food, were supposed to be smaller and more energetic. Some Hunts were Stalks.

Within this system, therefore:
(1) All Hunts are Lines.
(2) No Hunts are Lines.
(3) Some Hunts are Lines.
(4) Some Hunts are not Lines.
(5) None of the above.

29. Several peoples, though uncivilized by our standards, have a rather sophisticated tribal structure. One such tribe is the Mandes of the Bolivian Andes. Men called Execs are all Wormen, who are in charge of military affairs. Some Wormen, however, are not Poolmen.

Therefore:
(1) All Poolmen are Execs.
(2) No Poolmen are Execs.
(3) Some Poolmen are Execs.
(4) Some Poolmen are not Execs.
(5) None of the above.

30. According to history the Mandes carve stone in shops which are as distinct if form and function as in the works they produce. The Studia is a shop composed of men who rough-hew the stone. The men of the Bocci smooth the surface until the product is ready for the detail work of the Bettegi. Recent investigations, however, have shown that some Studias are actually Boccis. Whereas some of the Boccis are not Bettègis as originally hypothesized.

Therefore:
(1) All Bettegis are Studias.
(2) No Bettegis are Studias.
(3) Some Bettègis are Studias.
(4) Some Bettegis are not Studias.
(5) None of the above.

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(over)

31. The onward march of intellectual progress is continually changing the boundaries of knowledge, and consequently the organization of universities must change as well. One forward-looking institution, which shall be nameless, is planning for the year 2000 a large department of Jastrology, and all Inchologists will be Jastrologists This will be in the same building with the Kastrology Department, but some Jastrologists will not be Kastorians.

Therefore, in this university:
(1) All Kastorians will be Inchologists.
(2) No Kastorians will be Inchologists.
(3) Some Kastorians will be Inchologists.
(4) Some Kastorians will not be Inchologists.
(5) None of the above.

32. Because of the population pressures in this new university, all Beadniks will be enrolled as Fellows, with all the duties and privileges thereof. An extensive dormitory building program is projected to take care of the Studniks, and all Studniks will be Beadniks.

Therefore:
(1) All Studniks will be Fellows.
(2) No Studniks will be Fellows.
(3) Some Studniks will be Fellows.
(4) Some Studniks will not be Fellows.
(5) None of the above.

33. Intramural activities in the new university will be designated as U, V, and W events in order to accomodate all players. No U-players will be V-players because of limited facilities and scheduling. No V-players will be W-players. Computers will schedule playing times.

Therefore:
(1) All W-players will be U-players.
(2) No W-players will be U-players.
(3) Some W-players will be U-players.
(4) Some W-players will not be U-players.
(5) None of the above.

34. Current developements in the arts and sciences will eliminate the arbitrary distinction between university administration and poetry. A new department of Administics will be established. Some Biosophs will be Administers, however, because of the nature of their work. Some Administers will not be Sonneteers because of cultural lag.

Therefore:
(1) All Biosophs will be Sonneteers.
(2) No Biosophs will be Sonneteers.
(3) Some Biosophs will be Sonneteers.
(4) Some Biosophs will not be Sonneteers.
(5) None of the above.

35. Social events for women students in the university of the future will be organized by the Dean's office, with the help of the OO-COED computer, for the widest possible particicipation consistent with high scholarship. The card sorter will assemble the punched cards for a group to be called Comikes, which will all be Cojims, admitted to Cojim activities. The men's cards will be processed in the same way. No Cojims will be Cobills in the new system. The computer will see to that.

Therefore:
(1) All Comikes will be Cobills.
(2) No Comikes will be Cobills.
(3) Some Comikes will be Cobills.
(4) Some Comikes will not beCobills.
(5) None of the above.

36. Modern textbooks, adjusted to the progress of technology, are now being revised for the university of the future. So tests can be quickly obtained by machine some Slidebooks, which include illustrations for home projectors, are Punchbooks. Lightbooks, which can be read in the dark, will be widely used, and all Lightbooks are Slidebooks.

Therefore:
(1) All Lightbooks are Punchbooks.
(2) No Lightbooks are Punchbooks.
(3) Some Lightbooks are Punchbooks.
(4) Some Lightbooks are not Punchbooks.
(5) None of the above.

--the end--

LOGICAL READING TEST

1. The Pygian tribe lives in the mythical land of Id. Their favorite sport is the decathlon which is held on a tribal feast day. The men usually prepare for months in hopes of achieving the fame due the winner. As in our track meets there are long-distance runners, all of whom are Longmen. The J-men officiate, but plainly no Longmen are J-men.

   What is the correct conclusion from this paragraph?

   (1) All long-distance runners are J-men.
   (2) No long-distance runners are J-men.
   (3) Some long-distance runners are J-men.
   (4) Some long-distance runners are not J-men.
   (5) None of the above.

2. The agricultural characteristics of the Pygians are also interesting, because only they have been able to cultivate strains of vegetables in the dense forests of South America which are similar to those in North America. Some of the tubers are Dags, which are similar to our potatoes. Pygian festivals would not be complete without their favorite beverage, Pot, which is made from Oades. Some Oades are tubers, because of their particular characteristics.

   What can be concluded from this paragraph?

   (1) All Oades are Dags.
   (2) No Oades are Dags.
   (3) Some Oades are Dags.
   (4) Some Oades are not Dags.
   (5) None of the above.

3. One fine day a Peace Corps worker entered this peaceful land of Id. His intentions were to bring happiness and prosperity to these uncivilized natives. Noticing the happiness that Pot brought, he decided to increase the crop yield of Oades, its principal constituent. He decided to use a Potite fertilizer, but some Chlorides, which are especially good for the crops, are not Potites, so he must be careful. On further reading, however, he found that no Alkamid fertilizers are Potites. Thus, his decision was made.

   Therefore:

   (1) All Alkamids are Chlorides.
   (2) No Alkamids are Chlorides.
   (3) Some Alkamids are Chlorides.
   (4) Some Alkamids are not Chlorides.
   (5) None of the above.

(over)

4. Storytellers of the tribe contribute greatly to the education of the children as well as to the tribal mythology. In one of their tales some fairies who punish naughty children are not ghosts of deceased chieftains. These storytellers hasten to add that all ghosts of deceased chieftains are Shaws, which is important to the proper education of these infants.

According to this mythology you may conclude:
(1) All Shaws are fairies who punish naughty children.
(2) No Shaws are fairies who punish naughty children.
(3) Some Shaws are fairies who punish naughty children.
(4) Some Shaws are not fairies who punish naughty children.
(5) None of the above.

5. The Battle of the Zapotec is one of the Pygians' favorite heroic tales, for here the military wizardry of one-hundred starving, beleagured men repulsed the thousand-fold forces of the fierce Zapote Having been routed from their village, the Pygians were trapped in a canyon with steep cliffs on three sides, precluding any escape. Destitution then ordered all of the Stickmen to become Rockmen who mounted the escarpment and released a horrendous deluge of stones upon the enemy. Later, it was learned that some Bowmen were actually Stickmen before the battle.

Therefore:
(1) All Bowmen were Rockmen.
(2) No Bowmen were Rockmen.
(3) Some Bowmen were Rockmen.
(4) Some Bowmen were not Rockmen.
(5) None of the above.

6. Like many children of the forest, the Pygians worship many deities with equal reverence. All phantoms of the songs of night are Morgans. Some protectors of family shrines are not phantoms of the song of night.

If the above statements were true, you would conclude:

(1) All protectors of family shrines are Morgans.
(2) No protectors of family shrines are Morgans.
(3) Some protectors of family shrines. are Morgans.
(4) Some protectors of family shrines are not Morgans.
(5) None of the above.

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7. During the Renaissance, stonecutters were called Raphs, Michs, or Vinces according to their demonstrated techniques. Later, during a period of turbulent wars, all Michs were Vinces because of common political animosities. Some Vinces, however, were not Raphs due to their furious incompatability.

Therefore:
(1) All Raphs were Michs.
(2) No Raphs were Michs.
(3) Some Raphs were Michs.
(4) Some Raphs were not Michs.
(5) None of the above.

8. The tools of these stonecutters were named according to their function. Whereas to the apprentices all tools were of a distinct immutable classification, to the masters all Fents were Groads, because they could be used equally well in certain situations. No Groads were Lets, however, because of structural deficiencies.

Therefore:
(1) All Fents were Lets.
(2) No Fents were Lets.
(3) Some Fents were Lets.
(4) Some Fents were not Lets.
(5) None of the above.

9. Of the Bettegoes of Europe, the Florentine Bettego was by far the most famous. Most of the masters there were not of the Grannacii, one of the oldest and largest families in Florence. Due to an ancient papal edict, all Grannacii were prems in Florence, because of their special qualifications.

Therefore:
(1) All prems were masters.
(2) No prems were masters.
(3) Some prems were masters.
(4) Some prems were not masters.
(5) None of the above.

10. One of the most promising apprentices of the Florentine Bettego was George Sabaldi. Being an enthusiastic, aspiring youth, George had his mind set on carving the best statue of Pan ever produced. Engaging history as his guide he found the carving of a Pan was so difficult that many Pans were not statues to be admired for ages hence. The fatal blow to his callow character was his discovery that only some productions of the greatest sculptors were of the quality to be admired for ages hence.

From these statements you may conclude:
(1) All productions of the greatest sculptors were of Pan.
(2) No productions of the greatest sculptors were of Pan.
(3) Some productions of the greatest sculptors were of Pan.
(4) Some productions of the greatest sculptors were not of Pan.
(5) None of the above.

11. In that day to join silver and gold together into one solid ornament was a task for the most talented of smiths, who were all village leaders because of their special importance to the community. Some peers were the most talented smiths.

Therefore:
(1) All peers were village leaders.
(2) No peers were village leaders.
(3) Some peers were village leaders.
(4) Some peers were not village leaders.
(5) None of the above.

(over)

12. Today no Florentine copper artifacts are treasured objects because of the damage done in restoring them. The lost-wax castings, however, are well-preserved, but some of them are not treasured objects.

Therefore, according to this paragraph:
(1) All Florentine lost-wax castings are copper artifacts.
(2) No Florentine lost-wax castings are copper artifacts.
(3) Some Florentine lost-wax castings are copper artifacts.
(4) Some Florentine lost-wax castings are not copper artifacts.
(5) None of the above.

13. As technology advances and natural petroleum resources become more depleted, the securing of petroleum from unconventional sources becomes more imperative. One such source is the Athabasca tar sands of northern Alberta, Canada. Since some tar sands are sources of refinable hydrocarbons, these deposits are worthy of commercial investigation. Some Kerogen deposits are also sources of refinable hydrocarbons.

Therefore:
(1) All kerogen deposits are tar sands.
(2) No kerogen deposits are tar sands.
(3) Some kerogen deposits are tar sands.
(4) Some kerogen deposits are not tar sands.
(5) None of the above.

14. Geologists have found that all tar sands are bituminous sands which is important for finding oil deposits in this form. Likewise, some natural asphalt-sand mixtures are tar sands.

Therefore:
(1) All natural asphalt-sand mixtures are bituminous sands.
(2) No natural asphalt-sand mixtures are bituminous sands.
(3) Some natural asphalt-sand mixtures are bituminous sands
(4) Some natural asphalt-sand mixtures are not bituminous sands.
(5) None of the above.

15. The tar deposits of Athabasca are all potential sources of petroleum. Contrary to what was commonly believed prior to the formal investigation, some ancient gorcidian grove sites are not tar deposits.

Therefore, in this region:
(1) All ancient gorcidian grove sites are potential sources of petroleum.
(2) No ancient gorcidian grove sites are potential sources of petroleum.
(3) Some ancient gorcidian grove sites are potential sources of petroleum.
(4) Some ancient gorcidian grove sites are not potential sources of petroleum.
(5) None of the above.

6. None of the oil shale deposits of the Green River of Colorado have been found to be sand asphaltum. In this same region all kerogen deposits are oil shale deposits.

From this paragraph you may conclude:
(1) All Green River kerogen deposits are sand asphaltum.
(2) No Green River kerogen deposits are sand asphaltum.
(3) Some Green River kerogen deposits are sand asphaltum.
(4) Some Green River kerogen deposits are not sand asphaltum.
(5) None of the above.

7. In petroleum technology it is commonly known that all bituminous sands are oil sands. With the aid of high-speed computers and the recent influx of knowledge in this area, it was deduced that some oil sands are not oil fields which may be the cause of a depletion of our oil reserves.

If the above statements were correct you may conclude:
(1) All oil fields are bituminous sands.
(2) No oil fields are bituminous sands.
(3) Some oil fields are bituminous sands.
(4) Some oil fields are not bituminous sands.
(5) None of the above.

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8. Drs. Thomas and Kellner have found the reversible collapse of rabbits' ears to be resultant upon injection of certain enzymes. This is surely the most reliable of biological phenomenon, for with every injection of dizine the ears of the injected rabbit temporarily collapse. The discovery that some dizines are protelytic enzymes proved very useful to their research. With further investigation it was found that some fibrozines are protelytic enzymes which made the picture somewhat more complete.

Therefore:
(1) All fibrozines are dizines.
(2) No fibrozines are dizines.
(3) Some fibrozines are dizines.
(4) Some fibrozines are not dizines.
(5) None of the above.

9. After the failure of the Schwartzman reaction to detect any enzymatic change in the blood of the injected rabbits, Dr. Kellner intravenously injected fibrogen, and, after a thorough histological examination, found a cartilaginous malformation present only in the injected rabbits. This prompted the conclusion that some glucoids are not fibroids. A few more experiments made it evident that all fibroids were reactins, and the reactins were responsible for the observed reaction.

Therefore:
(1) All reactins are glucoids.
(2) No reactins are glucoids.
(3) Some reactins are glucoids.
(4) Some reactins are not glucoids.
(5) None of the above.

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(over)

20. Mathematics has become so specialized and sophisticated that the invention of a new mathematical system is relatively common. One such system is Dr. Mark Carr's system of chimerical geometry. In this system all gamma figures are Betas, which makes classification somewhat cumbersome. Unbeknowst to Carr, until after his first public presentation of this system, some Alpha figures are actually Gammas because of logical misconceptions.

Therefore, in this system:
(1) All Alpha figures are Betas.
(2) No Alpha figures are Betas.
(3) Some Alpha figures are Betas.
(4) Some Alpha figures are not Betas.
(5) None of the above.

21. In Carr's system some plane figures are not Gamma figures, which has been noted as a misclassification by many. All Zeta figures are universally accepted as plane figures.

Therefore:
(1) All Zetas are Gammas.
(2) No Zetas are Gammas.
(3) Some Zetas are Gammas.
(4) Some Zetas are not Gammas.
(5) None of the above.

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22. The Mians are a primative people who lived in the southern Andes around 400 B.C.. According to their religion, all Lynns are protectors of the home and are offered eels during festive ceremonies. As if to complicate anthropological research, the Mians maintain that all spirits inhabiting the tools of the village men are Lynns as well.

According to this religion, you may conclude:
(1) All spirits inhabiting the tools of the village men are protectors of the home.
(2) No spirits inhabiting the tools of the village men are protectors of the home.
(3) Some spirits inhabiting the tools of the village men are protectors of the home.
(4) Some spirits inhabiting the tools of the village men are not protectors of the home.
(5) None of the above.

23. Some ghosts who shield the men in battle are Kirbys. In addition some Kirbys are phantoms who live in the talking cave.

From this you may conclude:
(1) All phantoms who live in the talkingcave are ghosts who shield the men in battle.
(2) No phantoms who live in the talkingcave are ghosts who shield the men in battle.
(3) Some phantoms who live in the talking cave are ghosts who shield the men in battle.
(4) Some phantoms who live in the talking cave are not ghosts who shield the men in battle.
(5) None of the above.

24. Early in the Hopewell era these natives started making intricate decorative jewelry. Some decorative pins were Calima casts. Anthropomorphic figures are also found in these ruins, but some of them are not Calima casts.

According to this paragraph you may conclude:
(1) All anthropomorphic figures are decorative pins.
(2) No anthropomorphic figures are decorative pins.
(3) Some anthropomorphic figures are decorative pins.
(4) Some anthropomorphic figures are not decorative pins.
(5) None of the above.

25. The ancestors of the Mians lived in the Cobre region of the Andes. Here fiura furnaces were most frequently used, and some of these are not terra cotta furnaces. With recent excavations at these sites it has been found that all wind furnaces were fiura furnaces because of distinct similiarities in structure and mechanics.

Therefore:
(1) All wind furnaces were terra cotta furnaces.
(2) No wind furnaces were terra cotta furnaces.
(3) Some wind furnaces were terra cotta furnaces.
(4) Some wind furnaces were not terra cotta furnaces.
(5) None of the above.

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26. Dr. Barnes of NYU has invented the game of Quasee for students who want physical activity and have little room. It can be played in a 6 x 10 foot room with ping-pong paddles and a tennis ball. In such a small room two players cannot avoid physical encounters. Thus, such encounters are called lets, and all lets are fouls. Occasionally a player gets hit by a ball, but some hits are not lets. This makes scoring difficult at times.

Therefore:
(1) All fouls are hits.
(2) No fouls are hits.
(3) Some fouls are hits.
(4) Some fouls are not hits.
(5) None of the above.

27. After watching his students play this game, Dr. Barnes grouped them according to the tactics used. Such grouping could adequately be accomplished with A-, B-, and C- types. During the Spring tournament, however, he found that some A-types were undoubtedly B-types. Watching more closely, he also found that some C-types were not B-types because of the number of different strokes used.

Therefore:
(1) All C-types are A-types.
(2) No C-types are A-types.
(3) Some C-types are A-types.
(4) Some C-types are not A-types.
(5) None of the above.

28. Dr. Barnes' assistant, Jim Elliott, thought good players could be separated from others by classifying body types. Because of the nature of his sample, he concluded that no mesomorphs were leptosomes, which agreed with the theory of Kretchmer. He also found that some good players were mesomorphs.

Therefore:
(1) All good players were leptosomes.
(2) No good players were leptosomes.
(3) Some good players were leptosomes.
(4) Some good players were not leptosomes.
(5) None of the above.

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29. In the past it has been beneficial to classify people by the values they hold. In these terms none of the holders of influential primary values are Echinomorphs. In like manner no Dextromorphs are holders of influential primary values.

Therefore, in these terms you may conclude:
(1) All Dextromorphs are Echinomorphs.
(2) No Dextromorphs are Echinomorphs.
(3) Some Dextromorphs are Echinomorphs.
(4) Some Dextromorphs are not Echinomorphs.
(5) None of the above.

30. Some effectors of great personality changes are the terminal values of an individual. In addition, terminal values are all tertiary ones.

Therefore:
(1) All tertiary values are effectors of great personality changes.
(2) No tertiary values are effectors of great personality changes.
(3) Some tertiary values are effectors of great personality changes.
(4) Some tertiary values are not effectors of great personality changes.
(5) None of the above.

31. In this manner some Penses are not holders of tertiary values. Important to clinical classification is the fact that all schizmogentics are Penses.

Therefore:
(1) All schizmogentics are holders of tertiary values.
(2) No schizmogentics are holders of tertiary values.
(3) Some schizmogentics are holders of tertiary values.
(4) Some schizmogentics are not holders of tertiary values.
(5) None of the above.

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32. Ancient coins have now come under the scrupulous eye of the scientist. Combining numismatics with archaeology and statistics much can be learned about a people and their times from the coins they used as legal tender. From the Taxila hoard found in India it was determined that some Constantinian solidia were what the French numismatists had previously called "sou." All "sou" are known to be silver-based. This apparently led to the inflation that preceeded the Taxila decline.

Therefore:
(1) All Constantinian solidia were silver-based.
(2) No Constantinian solidia were silver-based.
(3) Some Constantinian solidis were silver-based.
(4) Some Constantinian solidia were not silver-based.
(5) None of the above.

33. The same hoard gave evidence that some Indian sovereigns were anna pieces. With constant handling the faces of these coins were worn to such an extent that only some of the gold coins were identifies as annas.

Therefore:
(1) All gold coins in this hoard were Indian sovereigns.
(2) No gold coins of this hoard were Indian sovereigns.
(3) Some gold coins of this hoard were Indian sovereigns.
(4) Some gold coins of this hoard were not Indian soveriegns.
(5) None of the above.

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34. Accurate models of molecular configurations have been as evasive as desirable to biochemists. Until recently such models have been impossible to construct, but with the aid of the computer such models are being constructed with the "construction and rotation" technique. It has been found that all cytodenes are gastromes. The oscilloscope screen somehow distorts such pictures, such that only recently it was found that some gastromes are not myoglobins.

Therefore.
(1) All myoglobins are cytodenes.
(2) No myoglobins are cytodenes.
(3) Some myoglobins are cytodenes.
(4) Some myoglobins are not cytodenes.
(5) None of the above.

35. Although some relationships are relatively easy to establish by this method, others are very resistant to analysis. One such example is the chained peptide group which is an element of most proteins. Once the analysis was complete, it could only be concluded that some chained peptide groups are not helical. Previously it was found that some heme groups are not helical.

Therefore:
(1) All heme groups are chained peptide groups.
(2) No heme groups are chained peptide groups.
(3) Some heme groups are chained peptide groups.
(4) Some heme groups are not chained peptide groups.
(5) None of the above.

36. Important to biochemists is the reactivity of these molecules. Determining the reactivity of any molecule, the total energy is minimized naturally by the particular sequential configuration. This free energy level also dictates that some active hybrids are active doublets. Because of their dynamic configurations, all active doublets are mercurial subunits.

Therefore:
(1) All mercurial subunits are active hybrids.
(2) No mercurial subunits are active hybrids.
(3) Some mercurial subunits are active hybrids.
(4) Some mercurial subunits are not active hybrids.
(5) None of the above.

APPENDIX B

Coversheet instructions for Groups 1-4 and 6

LOGICAL READING TEST

Remove the answer sheet from the test booklet and place (1) your name, (2) your student number, and (3) the name and form of the test in the appropriate places. Place a "Yes" or a "No" in the place marked "Instructor" answering whether or not you have previously had a class dealing with formal logic. Within this test you will find paragraphs each followed by five statements. Your task is to read each paragraph carefully, then, if a conclusion is deductible from the statements in the paragraph, select that conclusion from those given and mark that number on your answer sheet. If no conclusion is logical from the statements in the paragraph, mark option "5" on your answer sheet.

To avoid confusion the definition of the term "some" is to be "there exists at least one . . .." This is to say that you may not infer "some A are not B" from the statement "some A are B." Similarly, "some A are not B" does not imply "some A are B.

Work as fast as you can, but there should be ample time for you to finish. Be sure to answer every question, even if you have to guess.

Place no marks on this test booklet. There will be scratch paper provided.

DO NOT BEGIN UNTIL TOLD TO DO SO.

Coversheet instructions for Group 5

LOGICAL READING TEST

Remove the answer sheet from the test booklet and place (1) your name, (2) your student number, and (3) the name and form of the test in the appropriate places. Place a "Yes" or a "No" in the place marked "Instructor" answering whether or not you have previously had a class dealing with formal logic.

Within this test you will find paragraphs each followed by five statements. Your task is to read each paragraph carefully, then, if a conclusion logically follows from the statements in the paragraph, select that conclusion from those given and mark that number on your answer sheet. If no conclusion logically follows from the statements in the paragraph, mark option "5" on your answer sheet.

Work as fast as you can, but there will be ample time for you to finish. Be sure to answer every question, even if you must guess.

Place no marks on this test booklet. There will be scratch paper provided.

DO NOT BEGIN UNTIL TOLD TO DO SO.

Training Instructions for Group 1

LOGICAL READING TEST -- Form 1

Over the past few years several people in the Psychology Department at MSU have been studying reasoning behavior. These studies have found that people make predictable errors on certain types of verbal reasoning problems. If you took the Logical Abilities Test, you are already familiar with this type of problem. This will be an attempt to teach you how to better think your way through these problems and to eliminate these common errors. Therefore, if you learn and use these precautions, you will be better able to use the information given in each problem to decide whether or not a conclusion is possible, and if so which conclusion is the logically correct one. And it is likely that learning these precautions will eliminate some of the errors you make in similiar reasoning problems, such as drawing conclusions from a lab experiment or solving problems on aptitude tests.

The errors which have been found to be the most common have been explained by the "atmosphere error." In solving verbal problems of this type people are often influenced by similiarities between the statements from which the conclusion must be drawn.

For example:

All A's are B's.
All C's are B's.

Therefore, all A's are C's.

Stated this way the conclusion does not logically follow from these statements, but many people would conclude that such a conclusion is correct. This is because these people do not understand the relationships between the A's, B's, and C's which are dictated by the statements, and they are "solving" the problem by using the "all are" silimiarities between the statements to infer an "all are" conclusion which is incorrect in this example.

Two statements may contain the same elements of A's, B's, "are," and "all" but dictate relationships which are entirely different. In the above example, if "all C's are B's" were actually "all B's are C's," the conclusion would follow logically, but, eventhough the elements of the statements are the same, the relationships which are defined by each are so different that one allows the conclusion to follow logically, and the other does not. Thus, the possibility of a conclusion following logically from two statements depends upon the relationships defined, not necessarily upon the similiarities between the statements. Remember that, when solving problems of this type, you must fully understand the logical relationships which are defined by the statements.

If, by using these precautions, you find that none of the four conclusions follow logically from the paragraph, mark option "5," meaning "none of the above." This will mean either (1) you can find no conclusion which follows from the information given, or (2) you can find a conclusion which does follow, but none of the alternatives accurately states that conclusion.

Do not be fooled by the errors of naive reasoning which have just been explained to you.

You are encouraged to refer back to these instructions while you are taking this test.

When you have finished reading these instructions and you understand them, go on to the next page....

Training Instructions for Group 2

LOGICAL READING TEST -- Form 2

Over the past few years several people in the Psychology Department at MSU have been studying reasoning behavior. These studies have found that people make predictable errors on certain types of verbal reasoning problems. If you took the Logical Abilities Test, you are already familiar with this type of problem. This will be an attempt to teach you how to better think your way through these problems and to eliminate these errors. Therefore, if you learn and use these precautions, you will be better able to use the information given in each problem to decide whether or not a conclusion is possible, and if so which alternative is the logically correct one. And it is likely that learning these precautions will eliminate errors in similiar reasoning problems, such as drawing conclusions from a lab experiment or solving reasoning problems on aptitude tests.

The errors which are most common have been explained by the "conversion error." This is the incorrect conversion of an "all are" or a "some are not" statement in a problem. The correct solution for these problems have been determined by the use of the rules of formal logic. Thus, the conversion of statements must be correct by the rules of formal logic, or the conversion error will be committed. Often the "All A's are B's" statement is converted erroneously to "All B's are A's." The correct conversion is "all not B's are not A's." So, if you see an "all are" statement, make sure you convert it correctly if you do convert it at all.

Unlike the "all are" statement, the "some are not" statements cannot be converted correctly. "Some A's are not B's" is equivalent only to "some things which are not B's and A's," and this is not a conversion. The incorrect conversion which is usually made is to "some B's are not A's." Remember according to the rules of formal logic, which you must use to solve these problems correctly, "some A's are not B's" is not equivalent to "some B's are not A's."

For example:

All A's are B's.
All C's are B's.
Therefore, all A's are C's.

As it stands the conclusion does not follow logically from the statements. However, if the conversion error were committed "all C's are B's" were changed to "all B's are C's" the conclusion would follow logically. Avoid this invalid conversion; it can only lead you to errors in reasonig! Such answers as above are incorrect by the information given, and are scored as errors on this test.

It should be added that "all A's are not B's" can be converted to "all B's are not A's," and the statement "some A's are B's" can be converted to "some B's are A's." These conversions are transformations which lead to logically correct conclusions.

These correct conversions would be obviously correct if you substituted "cats" for A and "mammals" for B. And it is equally as obvious that "all cats are mammals" is not the same as "all mammals are cats." Nor is "some mamals are not cats" the same as "some cats are not mammals."

If, by using these precautions, you find that none of the four conclusions follow logically from the paragraph, mark option #5, "none of the above." This will mean either (1) you can find no conclusion which follows from the information given, or (2) you can find a conclusion which does follow, but none of the options accurately states that conclusion.

Do not be fooled by the errors of naive reasoning which have just been explained to you.

You are encouraged to refer back to these instructions while you are taking this test.

When you have finished reading these instructions and you feel you understand them, you may proceed with the test . . ..

Training I Instructions for Group 3

LOGICAL READING TEST--FORM 3

Over the post few years several people in the Psychology Department at MSU have been studying reasoning behavior. These studies have shown that people make predictable errors on certain types of verbal reasoning problems. If you took the Logical Abilities Test, you are already familiar with this type of problem. This will be an attempt to teach you how to better think your was through these problems and to eliminate these common errors. Therefore, if you can learn and use these precautions, you will be better able to use the information given in each problem to decide whether or not a conclusion is possible, and if so which conclusion is the logically correct one. And it is likely that learning these precautions will eliminate some of your errors in reasoning on similiar problems, such as drawing conclusions from a lab experiment or solving reasoning problems on aptitude tests.

The errors which have been found to be most common have been explained by the atmosphere and conversion errors. In solving verbal problems of this type people are often influenced by similiarities between the statements from which the conclusion is to be drawn.

For examples:
All A's are B's.
All C's are B's.

Therefore, all A's are C's.

Stated this was the conclusion does not logically follow from these statements, but many people would conclude that such a conclusion is correct. This is because these people do not understand the relationships between the A's, B's, and C's which are dictated by the statements, and they are "solving" the problem by using the "all are" similiarity between the statements to infer an "all are" conclusion which in this case is incorrect.

Two statements may contain the same elements of A's, B's, "are", and "all" but dictate relationships which are entirely different. In the above example, if "all C's are B's" were actually "B's are C's," the conclusion would follow logically, but, eventhough the elements of the statements are the same, the relationships which are defined by each are so different that one allows a logical conclusion to follow and one does not. Thus, the possibility of a conclusion following logically from two statements depends upon the relationships defined, not necessarily upon the similiarities between the statements. Remember that, when solving problems of this type, you must fully understand the relationships which are defined by the statements and base your conclusions on that.

Another error whcih has pervasive influence upon the way people reason is the coversionerror. Thsi is the incorrect conversion of an "all are" or a "some are not" statement in a problem. The correct solutions for these problems have been determined by the use of the rules of formal logic. Thus, the conversion of statements must be correct by the rules of formal logic. Thus, the conversion of statements must be correct by the rules of fomal logic, of the conversion error will be committed. Often the "all A's are B's" statement is converted erroneously to "all B's are A's." The correct conversion is "nothing which is not also a B can be an A." So, if you see and "all are" statement, make sute you convert it correctly if you do convert it at all.

Unlike the "all are" statement, the "some are not" statements cannot be converted correctly at all. "Some A's are not B's" is equivalent only to "some things which are not B's are A's" and this is not a conversion. The incorrect conversion which is usually made is to "some B's are not A's." Remember according to the rules of formal logic, which you must use to solve these problems correctly, "some A's are not B's" is not equivalent to "some B's are not A's."

For example:

All A's are B's.
All C's are B's.
Therefore, all A's are C's.

As it stands the conclusion does not follow logically from the statements. However, if the conversion error were committed so that "all C's are B's" were changed to "all B's are C's," the conclusion would then follow logically by virtue of that error. Avoid this invalid conversion; it can lead you only to errors in reasoning! Such answers as above are incorrect by the information given, and are scored as errors on this test.

It should be added that "all A's are not B's" can be converted to "all B's are not A's. These conversions are transformations which lead to logically correct conclusions.

These correct conversions would be obviously correct if you substituted "cats" for A and "mammals" for B. And it is equally as obvious that "all Cats are mammals" is not the same as "all mammals are cats." Nor is "some mammals are not cats" the same as "some cats are not mammals."

If, by using these precautions, you find that none of the four conclusions follow logically from the paragraph, mark option #5, "none of the above." This will mean either (1) you can find no conclusion which follows from the information givem, or (2) you can find a conclusion which does follow, but none of the options accurately states that conclusion.

Do not be fooled by the errors of naive reasoning which have been explained to you.

You are encouraged to refer back to these instructions while you are taking this test.

When you have finished reading these instructions and you feel you understand them, you may proceed with the test. . ..

Training Instructions for Group 4

LOGICAL READING TEST--FORM 4

Over the past few years several people in the Psychology Department at MSU have been studying reasoning behavior. These studies have shown that people make predictable errors on certain types of verbal reasoning problems. If you took the Logical Abilities Test, you are already familiar with this type of problem. This will be an attempt to teach you how to better think your way through these problems and to eliminate these common errors. Therefore, if you learn and use these precautions, you will be better able to use the information given in each problem to decide whether or not a conclusion is possible, and if so which conclusion is the logically correct one. And it is likely that learning these precautions will eliminate some of your errors in reasoning on similiar problems, such as drawing conclusions from a lab experiment or solving reasoning problems on aptitude tests.

The errors which occur most commonly have been explained by the attributed equivalence between two given sets of elements. Consider A and B as sets of all possible individual A's and B's., i.e., consisting of elements A's and B's. If the statement "all A's are B's" were given, many people would interpret it to mean that the set A was equivalent to set B, i.e., that they contained the same elements. To be true every element of set A would have to be an element of set B, and vice versa. Although this may be often true in real life, in the problems which follow you will not be able to judge the equivalence of the sets by the meaning of the names involved, for they will be unfamiliar to you.

Therefore, you must assume for "all A's are B's" that A is a set of fewer elements than B. I you restated "all A's are B's" to "all A's are elements of set B" or to "all A's are included in the set B," the relationships intended would be as obvious as if they were stated like "all cats are mammals." Obviously the set "cats" is smaller than the set "mammals," for each mammal is not a cat.

In this manner, "all A's are B's" becomes "all A's are elements of set B."

"No A's are B's" becomes "no A's are elements of set B."

"Some A's are B's" becomes "some A's are elements of set B."

"Some A's are not B's" becomes "some A's are not elements of set B."

It would be to your benefit to actually verbalize these transformations for the first few problems. Always remember that the first set will always contain fewer elements than the other, and in that way they are not equivalent sets.

If, by using these precautions, you find that none of the four conclusions follow logically from the paragraph, mark option #5, "none of the above." This will mean either (1) you can find no conclusion which follows from the information given, or (2) you can find a conclusion which does follow, but none of the options accurately states that conclusion.

Do not be fooled by the errors of naive reasoning which have just been explained to you.

You are encouraged to refer back to these instructions which you are taking this test.

When you have finished reading these instructions and you feel you understand them, you may proceed with the test....

Training Instructions for Group 5

LOGICAL READING TEST -- Form 5

Over the past few years several people in the Psychology Department at MSU have been studying reasoning behavior. These studies have shown that people make predictable errors on certain types of verbal reasoning problems. If you took the Logical Abilities Test, you are already familiar with this type of problem. This will be an attempt to teach you how to bettwe think your way through these problems and to eliminate these common errors. Therefore, if you learn and use these precautions, you will be better able to use the information given in each problem to decide whether or not a conclusion is possible, and if so which conclusion is the logically correct one. And it is likely that learning these precautions will eliminate some errors in reasoning on similiar problems, such as drawing conclusions from a lab experiment or solving reasoning problems on aptitude tests.

The errors which most commonly occur have been explained by the implied inclusion or exclusion of a "some" statement. Many people regard the statement "some A's are B's" as implying that "some A's are not B's." Thisis a common error which may be eliminated if you define the term "some" to mean "at least one." You know about some of the objects, but any others which may exist are unknown to you. Thus, you cannot be certain about their characteristics. Thus, the statement "some A's are B's" is meant to be interpreted as "at least one thing exists which is both A and B." Stated this correct way this statement does not imply "some A's are not B's."

Similiarly the statement, "some A's are not B's" does not imply "some A's are B's."

If, by using these precautions, you find that none of the four conclusions follow logically from the paragraph, mark option #5, "none of the above." This will mean either (1) you can find no conclusion which follows from the information given, or (2) you can find a conclusion which does follow, but none of the options accurately states that conclusion.

Do not be fooled by the errors of naive reasoning which have just been explained to you.

You are encouraged to refer back these instructions while you are taking this test.

When you have finished reading these instructions and feel you understand them, you may proceed with the test....