THE EFFECTIVENESS OF LOGICAL REASONING ON
THE SOLUTION OF VALUE PROBLEMS

by

CHUCK SEYMOUR SCHACTMAN

B.Sc., McGill University, 1970

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS

in
THE FACULTY OF GRADUATE STUDIES
in
THE DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

We accept this thesis as conforming to the
required standard

The University of British Columbia
April, 1976

© Chuck Seymour Schactman, 1976
In presenting this thesis in partial fulfilment of the requirements for
an advanced degree at the University of British Columbia, I agree that
the Library shall make it freely available for reference and study.
I further agree that permission for extensive copying of this thesis
for scholarly purposes may be granted by the Head of my Department or
by his representatives. It is understood that copying or publication
of this thesis for financial gain shall not be allowed without my
written permission.

Department of Educational Psychology

The University of British Columbia
2075 Wesbrook Place
Vancouver, Canada
V6T 1W5

Date April 30, 1976.
Abstract

Certain values education programs have been recently developed which emphasize teaching students to gain ability in critical, deductive reasoning. The major contention of this paper was that this type of reasoning is not entirely adequate for the solution of certain value loaded problems. In order to empirically test this hypothesis, a group of university students trained in formal logic was selected. Then three tests of logic were devised -- one symbolic, one verbal and neutral, and the third verbal and value loaded. On three different sessions these tests were administered so that each subject attempted each test. Every item across the three tests was exactly the same in terms of logical content. The results were then tabulated and the analyses performed. The results showed support for the major hypothesis, that subjects perform significantly different on tests incorporating the same logic, but whose content differs. These results were then viewed in relation to values education programs stressing deductive reasoning and to the educational implications that may arise. Finally it was concluded that if transfer of learning to real life situations is a goal of education, then the programs mentioned are insufficient for the realization of these goals, and that the inclusion of educational procedures in the affective and perceptual, as well as the cognitive domains, is necessary for the successful transfer of learned strategies to everyday life situations.
# Table of Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction and Statement of the Problem</td>
<td>1</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>6</td>
</tr>
<tr>
<td>Rationale for this Study</td>
<td>7</td>
</tr>
<tr>
<td>2. Review of the Literature and Specific Objectives of this Study</td>
<td>9</td>
</tr>
<tr>
<td>Moral and Values Education</td>
<td>9</td>
</tr>
<tr>
<td>Logical Deduction</td>
<td>13</td>
</tr>
<tr>
<td>Objectives of this Study</td>
<td>14</td>
</tr>
<tr>
<td>3. Method</td>
<td>16</td>
</tr>
<tr>
<td>Subjects</td>
<td>16</td>
</tr>
<tr>
<td>Test Development</td>
<td>17</td>
</tr>
<tr>
<td>Procedures</td>
<td>19</td>
</tr>
<tr>
<td>Design</td>
<td>20</td>
</tr>
<tr>
<td>4. Results</td>
<td>21</td>
</tr>
<tr>
<td>Analysis of Variance</td>
<td>21</td>
</tr>
<tr>
<td>Content Area</td>
<td>26</td>
</tr>
<tr>
<td>Summary</td>
<td>29</td>
</tr>
<tr>
<td>5. Discussions and Conclusions</td>
<td>30</td>
</tr>
<tr>
<td>Educational Implications of this Study</td>
<td>32</td>
</tr>
<tr>
<td>Reference Notes</td>
<td>36</td>
</tr>
<tr>
<td>References</td>
<td>37</td>
</tr>
<tr>
<td>Appendix A - Test Forms</td>
<td>40</td>
</tr>
<tr>
<td>Appendix B - Administration Instructions</td>
<td>53</td>
</tr>
</tbody>
</table>
List of Tables

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Design Paradigm with Cell and Marginal Means and Cell Standard Deviations</td>
<td>22</td>
</tr>
<tr>
<td>2. Analysis of Variance Summary Table for a 6 By 3 Factorial Design with Repeated Measures on the A Dimension</td>
<td>23</td>
</tr>
<tr>
<td>3. Tests on Contrasts Using the Scheffé Method</td>
<td>25</td>
</tr>
<tr>
<td>4. Analysis of Variance Summary Table for a 2 By 2 Factorial Design with Repeated Measures on the A Dimension</td>
<td>27</td>
</tr>
<tr>
<td>5. Number of Errors Across Equivalent Items on all Forms and Content Area of Valued Items</td>
<td>28</td>
</tr>
</tbody>
</table>
CHAPTER 1
Introduction and Statement of the Problem

Of major importance to the utility of our educational system is the transfer of learned abilities from within the confines of our educational institutions to situations the individual will face in his everyday life. Hopefully our educational system does not operate in a vacuum and does provide the individual with some useful means for handling "real life" situations. Therefore, transfer of learning is one of the most important objectives in our educational system. Methods and usage of acquired knowledge must be transferable to other than the restricted academic environment.

The fact that most of what we learn is intended for application to problem situations in real life is indicative of the importance of application objectives in the general curriculum. The effectiveness of a large part of the school program is therefore dependent upon how well the students carry over into situations, applications which the student never faced in the learning process. (Bloom, 1956, p. 122)

Psychological research has attempted to understand the changes that an individual goes through during, and as a result of,
a training procedure. What are the effects on the individual of a consistent training program in a given area? Much of the research on the theory of "set" has been summarized by Young (1961). A set is assumed to increase the probability of occurrence of certain responses, and to decrease the probability of occurrence of other responses, usually through the selection, direction, and re-organization of some part of experience. Set influences the choices made. Faced with particular situations and problems we are predisposed to respond in particular ways. Therefore, specific educational practices should build sets and predispose the student to handle similar situations in a like manner, as well as inhibiting responses in other situations. That is, the creation of a set can result in a recurring response pattern similar to the training procedures, but this pattern may be consistent with certain educational objectives, contrary to other objectives, or a combination of consistency and contrariness. This latter circumstance would likely result as a consequence of a training procedure based on vague and undefined objectives. However, given the delineation of desired goals, the creation of a set may predispose the individual to respond in congruence with these goals and to transfer this predisposition to situations that are similar in environment to the training procedures.

If an educational program creates a set within an individual to
respond similarly across like situations, then transfer will occur at least across a narrow range. However, further transfer to real life situations is necessary to fulfill Bloom's criteria of the effectiveness of a program. Yet, most people find it almost impossible to solve real life problems with any consistency, regardless of academic ability or training procedures.

But common observation would indicate that individuals in general tend to avoid real problem solving. When presented with problems, they usually apply a limited stock of techniques to them and are frequently satisfied if a partial solution is obtained. If the techniques do not work, there is a strong tendency either to reorder the problem completely, or to escape from it entirely. (Bloom, 1956, pp. 42-43)

A major objective of our educational system is the transfer of learning from the school environment to more realistic problems, yet it seems unable to provide enough or adequate strategies for an individual to realize this goal. If transfer of learning is to be retained as an educational objective, then it is necessary to describe training procedures that develop novel and more adequate strategies for the individual in his everyday life. The wide discrepancy between desired transfer of learning and actual life
performance must be accounted for in the development of these new training programs.

A large amount of educational interest has recently been generated in the area of moral education, value situations, and real life problems. In the past the public school system has overtly avoided this area, but through the schools' and teachers' attitudes and actions, and through the values implied in the curriculum, the values of our society have been covertly transmitted. Presently, with the view that our society has lost the ability to transmit socially appropriate values with any consistency, the educational system has begun research in this area to attempt development and implementation of programs designed to enhance an individual's understanding and ability in dealing with value situations and problems.

A large number of these researchers (Coombs, 1971; Meux, 1971; Kohlberg & Mayer, 1972) are approaching the problem of values education through the development of critical, deductive skills to be learned by their students. For example, Meux (1971) has developed an intricate system of value analysis based on the differentiating ability of students to reason deductively through value problems.

It is the belief of these researchers that the development of logical and critical thought is the most appropriate way to handle
issues involving moral or value decisions. It is felt that development of critical thinking will enable the student to rationally encounter and solve problems in his everyday life. These critical thinking skills are thought to be heavily cognitive in nature (Scriven, 1975; Hoffman, 1970), and so the training procedures are highly cognitive. These skills are a series of strategies and techniques to be learned by the individual so that he will be better able to analyze his value problems. These strategies include the differentiation of arguments into their logical components, the differentiation of factual, value, and inferential statements, the ranking and ordering of value arguments, the utilization of consistent systems for the judgement of value conflicts, and many other strategies.

The purpose of this study is to examine the appropriateness of training procedures which utilize as their main approach the development of highly cognitive, critical skills in students. To examine this problem a set of deductive reasoning tasks, which differed in content area, were administered to subjects who had already acquired a significant amount of skill in deductive analysis. The effect of content on the subjects' performances was analyzed to discover if these trained subjects were consistently able to utilize their learned strategies across these differing content areas.
Definition of Terms

Transfer of learning. Given a certain training procedure, transfer of learning can be defined as the ability of an individual to perform a series of tasks that are similar to the training tasks, yet different from them to a certain degree. This degree of difference can be very broad or very narrow. This study deals with a narrow range of differences between training procedures and performance measures. Since these tasks are equivalent on the deductive reasoning dimension, then individual developmental differences in rate of learning will not be a factor affecting the subject's performance on this dimension.

Logical analysis. This is concerned with the relationship between a conclusion and the evidence given to support it. It deals with arguments and inferences and distinguishes those which are logically correct from those which are not (Salmon, 1973).

Symbolic form. If p, then q.

p.

Therefore, q. (Salmon, 1973)

Neutral verbal form. If Smith fails his English exam, then he will be disqualified for the homecoming game.

Smith fails his English exam.

Therefore, Smith will be disqualified for the homecoming game.
Valued verbal form. If homosexuals are human, then they are moral.

Homosexuals are human.

Therefore, homosexuals are moral.

All of the above forms are logically correct and are exact copies of one another in terms of logical analysis.

Rationale for this Study

In this study it is the notion of transfer of learning, as previously defined, that is explored. All subjects are similarly trained and are then given a series of tasks that are identical to each other in logical content, but differ from each other in format. The letters S, N, and V stand for symbolic form (S), neutral form (N), and valued form (V). The symbolic form is most like the training program and in fact will provide baseline data as to the efficiency of the training method.

The ability to look at problems in a logical manner, that is, to analyze the situation according to logical rules, is for most people dependent upon a certain degree of specific training. Those people who are well trained in logical analysis have reached an educational level well above the average and have achieved the capability for highly critical thought. It could be assumed, then, that these people should best be able to logically handle simple problems that are situationally similar.
Is the individual trained in value analysis as able to deal with heavily value loaded situations as with less valued, more neutral situations? More specifically, across a series of transfer tasks whose range is very narrow (S to N to V) is performance dependent upon the nature of the test form, that is, is performance across forms equal? The object of this study was to test the prediction that performances of the same individual across the three test forms, which are equivalent in logical content, will significantly differ. Since it is felt that ability in logical analysis is affected by the value content of the problem, it is hypothesized that greater differences between the symbolic, neutral, and valued conditions would occur at the valued condition due to the assumed added emotional component at this condition.
CHAPTER 2

Review of the Literature and Specific Objectives of this Study

In this chapter a review of the literature pertinent to the proposed research will be presented. Two areas will be dealt with - the literature surrounding the development and implementation of educational policies in the area of values education, specifically related to the enhancement of critical thinking abilities, and a brief overview of logical systems, how they operate, and, in particular, the relationship of validity and truth. The specific objectives of this study will also be stated.

Moral and Values Education

Coombs (1971) has listed four major objectives of value analysis in the classroom. They are:

1. To teach students that values can be rated.
2. To help students make the most rational, defensible value judgement possible.
3. To equip students with the capacity and inclination to make that judgement.
4. To teach students group dynamics and cooperation in arriving at a common value judgement.

An elaborate system for resolving value conflicts based on rational principles has been described by Meux (1971). He has
proposed the following principles as part of the rational process of value conflict resolution.

1. Analyze value conflicts into their logical components.
2. Differentiate logical components of the value analysis to reduce differences.
3. Reinterpret value objects, criteria, principles, and situations to reduce differences.
4. Appeal to epistemic rules wherever relevant.

Smith (1963) has attempted to show that since logic is related to language, and language is the essence of teaching, it is necessary to teach logic itself to the students, as well as having the teachers sufficiently well trained in this area.

Thus, the emphasis of these three researchers is on the development of logical systems. Conklin (1974) has stated that the function of education is to help the student clarify his own values, beliefs, and thought through a system of critical analysis, so his actions will at least be personally rational. He feels that education should give people the faith that real rationality exists and the zeal to pursue it.

A programmed text for the tasks in the value analysis as proposed by Meux and Chadwick (1971) has been developed by Casper (1971). It is divided into a series of six separate lesson units comprising the following areas: ratings and descriptions,
criterions, ranking and grading, logic and principles, principle statements, and comparison class and point of view.

The cognitive developmental approach to moral development is best represented by Piaget and Kohlberg (Hoffman, 1970; Kohlberg, 1971). Kohlberg and Mayer (1972) argue for a sequential development of the child aided by guidance from and adherence to a set of universal truths. By following rational, ethical principles the individual will be most able to arrive at the rationally correct decision. Allowing the child to progress on his own, guided by these principles, will result in the child achieving a greater level of moral development. Kohlberg and Mayer state that the development of logical and critical thought will result in a broader set of moral values.

Kohlberg and Mayer, Coombs, Meux, Conklin, Chadwick, Casper, and Smith all agree on the need to develop rational, critical thought through which value decisions and judgements will be made more thoroughly and easily. Elaborate instructional systems for classroom implementation of increasing the scope and ability for critical thought have been developed. One in particular will be discussed below.

A note from the Association for Values Education and Research (AVER, Note 1), operating at the University of British Columbia, describes the major questions to be dealt with through its research.
These are:

1. How do people reason about different kinds of questions?

2. What skills, abilities, capabilities, and concepts must people master to make various kinds of value judgements in a rational way?

3. What factors influence the likelihood that rational ways of reasoning and acting will be adopted?

The stress is again on the development of rational ways of reasoning to master value problems. It logically follows that a training program that emphasizes the means for acquiring this type of critical analysis would greatly facilitate people facing value questions.

The AVER training program (Note 2, Note 3) are a combination of "Kohlbergian" programs (Rest, 1974), and a more formal, critical approach to value problems through implementation of rational analysis. The AVER testing program (Note 2, Note 3) has yielded some fascinating and contradictory results. One of the tests used was a reasoning test called the Conditional Reasoning Test. It consisted of two sentence arguments and a conclusion, and the student was to decide if the conclusion was sound or unsound reasoning. For example:

Suppose you know that:

All Indians are human beings.

All human beings deserve to be treated fairly and with respect.

Would it be sound or unsound reasoning to conclude that:

All Indians deserve to be treated fairly and with respect.
The test items were equally divided into neutral and non-neutral, valued items. It was found that overall performance on the neutral items was superior to that on the non-neutral items. On a similar test in 1975 (AVER, Note 3) only valued items were used. It was found that there was total test improvement as a result of training, but some item scores improved while others declined. There are some indications from these findings that a critical, deductive training program aids neutral argument analysis and reasoning, but is inconsistent in aiding value argument analysis and reasoning.

Logical Deduction

In the introductory logic course taught at the University of British Columbia, the initial class periods are given to a discussion of the notion of validity and truth. In elementary textbooks on symbolic logic (Lambert & van Fraassen, 1972; Salmon, 1973; Resnick, 1970) the introductory chapters also deal with this same topic.

The definition of validity is usually given by a definition of invalidity. An invalid argument is one whose premises (statements of an argument) are all true and whose conclusion is false. The distinction between the truth of the statements and the validity of an argument is most significant. Statements can be true or false, while arguments are either valid or invalid, but neither true nor false. The system of deductive logic is primarily
concerned with the logical relationships between statements comprising an argument, and less concerned with their actual truth or falsity. Arguments can be valid even though their statements are false. For example:

If silver were gold, then everyone would be rich.  (false)
Silver is gold.  (false)
So everyone will be rich.  (false)  (Resnick, 1970)

This difference between validity of the argument and truth of the statements is the most significant idea to be mastered before any system of deductive logic can be learned. Once this is accomplished the particular deductive system can then be followed.

Objectives of this Study

There has been a large amount of research that has occurred in the development of strategies and practices to increase the student's abilities at critical, deductive analysis in order to provide him with certain skills that have been deduced to be a necessary prerequisite to engaging value problems successfully. But is skill in deductive reasoning sufficient to enable an individual to better handle his value problems?

The purpose of this study is to test the ability of well trained, university age students to handle value, neutral, and symbolic problems. If these students are asked to determine the validity or invalidity of an argument, then the truth of the premises should not matter. It is the major contention of this paper that the truth of the premises is the overriding concern in
value issues and this precludes the possibility of discerning validity objectively. Personal input will be more important in the final decision than existing logical structures. That is, the strategies that have been learned are useful in determining the notion of logical validity, but are not useful in determining the notion of truth or falsity of statements. The truth of a statement is dealt with through the individual's personal beliefs, attitudes, values, and morals. The additional impact of the emotive nature of the value condition will cause an inconsistency in personal performance. Moreover, this personal or emotive input can operate across tasks that are very near to the training procedures, so that if transfer of learning does not occur across this narrow range, it is likely that little transfer will occur to situations that are more remote from the training situation, such as, real life situations.
CHAPTER 3

Method

In this chapter the specific methodology of this experiment will be discussed. In particular, reference will be made to the sample used, to the development of the test measures, to the development of scoring criteria for the measures, to the actual procedures performed during the collection of the data, and to the design paradigm which this experiment followed.

Subjects

The subjects were a sample of University of British Columbia students enrolled in the elementary logic course conducted by the philosophy department. The subjects were taken from two class sections—fifteen in one, and seventeen in the other. This logic course (Philosophy 302) is a basic introductory course in symbolic and verbal logic, and in the development of a logical system based on natural deduction. The reference textbook was by Lambert and van Fraassen (1972). At the time of testing the students had been enrolled in this one semester (fifteen weeks) course for twelve weeks. The course itself constituted the training program for these students. Since eighty per cent of the course had been completed at the time of testing, the subjects were sufficiently well trained for the degree of task difficulty in this experiment.
The total sample size was 32, randomly split into six groups consisting of 4, 5, 5, 6, 6, and 6 subjects.

Test Development

The development of the test measures began after an investigation of the logic literature and consultation with the instructors of the logic course. After it was understood what the course specifically entailed, an eight question test of symbolic logic was constructed. With the instructors' observations, the test was modified to enable the students to perform at least at the 75 per cent level (6.0 out of 8.0), as judged by the instructors. This completed form constituted form S—an eight question test of symbolic logic, asking the students for the validity or invalidity of the arguments. (This test along with form N and form V are located in Appendix A.)

On the basis of form S, the two verbal forms were constructed. For each symbolic argument, a neutral and a valued argument were devised each consisting of exactly the same logical content. Thus, form N consisted of eight neutral arguments and form V consisted of eight valued arguments, both in verbal sentence format. A pool of these sixteen items was given to three external observers to rate as either 1—low emotive content, relatively neutral, or 2—high emotive content, high value loading. Each item was rated
by all three observers and one hundred per cent concurrence was obtained. All eight low emotive items constituted the neutral form N, while all eight high emotive items constituted the valued form V. The observers were all university graduates, either professionally involved in education or extending their learning through graduate degree programs.

Since the total number of words used in each argument might have confounded the results, this variation in verbosity was considered in the construction of forms N and V. Although not exactly equal, the mean argument length for form N was 40.8 words. The mean argument length for form V was 47.6 words. This difference was not significant at the .05 level of significance, \( t(14) = .3, p > .05 \).

Of prime importance to this study was the equivalence of logical content for each argument. Three logicians determined the equality of logical content across the three forms by deciding the validity or invalidity of the arguments on form N and form V, and by a comparison with form S. There was 100 per cent concurrence by all logicians across all forms. As well, the preliminary instructions were the same on all forms. These instructions were developed on the basis of asking for personal opinions in regard to the answering of the questions on all forms. Since the notion of validity is a logical constant over all other dimensions, such as,
truth of premises or content area, then "personal opinions" was only a diversionary factor unrelated to validity. The instructions on all three test forms were identical and are included in Appendix A with each test form.

The scoring criteria for all three forms was the same, that is, a '1' was given for the correct answer (as determined by the instructors, either valid or invalid depending upon question), and a '0' for an incorrect answer. Eight was the highest score obtainable on each form.

**Procedures**

Previous to the testing sessions the form order had been randomly assigned over the first and subsequent days. As arranged with the instructors of the course, testing was performed over a two week period in three class sessions. The last 20 minutes of class time was assigned for the experiment. The testing was conducted by the author without any assistance from the instructors. The following is an abreviated description of the instructions which were given on the first day. (A complete description is included in Appendix B.) The examiner briefly described his area of interest as problem solving and thanked the students for their cooperation. He stressed his interest in the subjects' personal opinions and honesty and stated that this information would be
anonymous and confidential. The students were asked not to talk amongst themselves about the experiment until after the third testing session. The tests were then administered and as each subject finished he handed in his paper and left. On the two subsequent sessions the examiner stressed his interest in personal opinions and then administered the questionnaire.

**Design**

All subjects were given all three test forms in random order. Therefore, the design was a two factorial (form type by form order) repeated measures design. In the repeated measures design, form order was represented as treatment effect B, form type was represented as treatment effect A, and subjects were represented by effect S. This design followed the format as described by Dayton (1970, p. 293) for evaluating carry-over effects in a repeated measures design.
CHAPTER 4

Results

Table 1 represents a summary of the design paradigm for this experiment with cell and marginal means and cell standard deviations included. A two factorial repeated measures analysis of variance with unequal cell sizes was performed on the obtained data.

Analysis of Variance

The symbols used in the analysis of variance are defined as:
1. Factor A = form type (three levels).
2. Factor B = form order (six levels).
3. Factor S = subjects (32 subjects).

Table 2 is a summary table of the analysis of variance for a three by six factorial design with repeated measures on the A dimension, with unequal cell sizes. The test of form order was not significant, $F(5, 26) = 1.1416, p < .35$.

Since the design is repeated measures, assumptions of the homogeneity of variance and covariance must be dealt with for factor A and for the interaction factor AB (Dayton, 1970; Winer, 1962). To do this, the within subjects tests were carried out with conservative degrees of freedom. Thus, factor A was evaluated with 1 and 26 degrees of freedom, $F(1, 26) = 7.72$, as well as
<table>
<thead>
<tr>
<th>Form Order (B)</th>
<th>S (n = 32)</th>
<th>N (n = 32)</th>
<th>V (n = 32)</th>
<th>Marginal</th>
</tr>
</thead>
<tbody>
<tr>
<td>S N V</td>
<td>5.75^a</td>
<td>5.75</td>
<td>4.25</td>
<td>5.25</td>
</tr>
<tr>
<td>(n = 4)</td>
<td>1.26^b</td>
<td>1.96</td>
<td>.96</td>
<td></td>
</tr>
<tr>
<td>S V N</td>
<td>7.17</td>
<td>6.67</td>
<td>6.63</td>
<td>6.72</td>
</tr>
<tr>
<td>(n = 6)</td>
<td>.75</td>
<td>1.37</td>
<td>1.37</td>
<td></td>
</tr>
<tr>
<td>N S V</td>
<td>6.67</td>
<td>5.67</td>
<td>4.33</td>
<td>5.56</td>
</tr>
<tr>
<td>(n = 6)</td>
<td>.82</td>
<td>1.75</td>
<td>1.75</td>
<td></td>
</tr>
<tr>
<td>N V S</td>
<td>6.60</td>
<td>6.20</td>
<td>4.20</td>
<td>5.67</td>
</tr>
<tr>
<td>(n = 5)</td>
<td>1.52</td>
<td>.84</td>
<td>1.48</td>
<td></td>
</tr>
<tr>
<td>V S N</td>
<td>6.83</td>
<td>5.50</td>
<td>5.33</td>
<td>5.89</td>
</tr>
<tr>
<td>(n = 6)</td>
<td>1.17</td>
<td>2.07</td>
<td>1.75</td>
<td></td>
</tr>
<tr>
<td>V N S</td>
<td>5.80</td>
<td>5.80</td>
<td>5.00</td>
<td>5.33</td>
</tr>
<tr>
<td>(n = 5)</td>
<td>1.64</td>
<td>1.79</td>
<td>1.73</td>
<td></td>
</tr>
<tr>
<td>Marginal</td>
<td>6.53</td>
<td>5.94</td>
<td>4.97</td>
<td>5.81</td>
</tr>
</tbody>
</table>

^aCell means.

^bCell standard deviations.
Table 2
Analysis of Variance Summary Table for a 6 By 3 Factorial Design with Repeated Measures on the A Dimension

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>21.4748</td>
<td>4.2949</td>
<td>1.1416</td>
</tr>
<tr>
<td>S</td>
<td>26</td>
<td>97.8166</td>
<td>3.7622</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>39.3637</td>
<td>19.6819</td>
<td>15.0509*</td>
</tr>
<tr>
<td>AB</td>
<td>10</td>
<td>11.5207</td>
<td>1.1521</td>
<td>0.8810</td>
</tr>
<tr>
<td>AS</td>
<td>52</td>
<td>67.99997</td>
<td>1.3077</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>95</td>
<td>238.625</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( B^a \) Factor B = form order

\( S^b \) Factor S = subjects

\( A^c \) Factor A = form type

\( *p < .01 \)
with 2 and 52 degrees of freedom, \( F(2, 52) = 5.10 \). The F value for the main effect of form type was computed as \( 15.0509 \), which is greater than the conservative and usual F ratios. Thus, form type is significant at beyond the .01 level. For the interaction effect AB, the computed value of F is below 1, which was not significant at both the conservative (df = 1, 26) and regular (df = 2, 52) levels. Since the tests of both the A and AB effects were unambiguous at both the usual and conservative degrees of freedom, the tests for the homogeneity of variance and covariance were not necessary. Thus, the main effect of form type was significant at beyond the .01 level, while the effect of form order, B, and the interaction effect of form order by form type were not significant.

Post hoc comparisons of the mean differences on factor A, form type, were computed according to Marascuilo (1971). The standard errors for each of the mean contrasts were computed. Then the contrasts were compared to a Scheffé value with an F at the .01 level of significance with 2 and 52 degrees of freedom. These results are illustrated in Table 3.

It can be seen that contrasts 2 and 3 were significant at the .01 level, while contrast 1 was not significant. Therefore, the significant main effect of form type can be attributed to differences between form V and form N and to differences between
### Table 3
Tests on Contrasts Using the Scheffe' Method

<table>
<thead>
<tr>
<th>Contrasts</th>
<th>Mean Square Residual</th>
<th>Standard Error</th>
<th>Scheffe' Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $x^a_S - x^b_N$</td>
<td>1.3078</td>
<td>.2859</td>
<td>.915</td>
</tr>
<tr>
<td>2. $x^b_N - x^c_V$</td>
<td>1.3078</td>
<td>.2859</td>
<td>.915</td>
</tr>
<tr>
<td>3. $x^c_S - x^c_V$</td>
<td>1.3078</td>
<td>.2859</td>
<td>.915</td>
</tr>
</tbody>
</table>

\( a \) \text{X} = \text{mean score on form S = 6.53.} \\
\( b \) \text{X} = \text{mean score on form N = 5.94} \\
\( c \) \text{X} = \text{mean score on form V = 4.97} \\
\*p < .01
form V and form S. The mean of the valued form significantly differs from the means of the neutral and symbolic forms, whereas the means of the symbolic and neutral forms do not significantly differ from each other.

Table 4 illustrates a further post hoc comparison of the variance. In this analysis, performance scores on the symbolic form were blocked at the mean (6.53) to form two groups — one group high in performance on the symbolic form (n = 19), and the other group low in performance on the symbolic form (n = 13). The analysis then compares each of these groups' performances on the neutral and valued forms. The results show that there was a significant F at the .01 level for form type, a significant F at the .05 level for the high-low dimension, and a non-significant F for the interaction effect. This last result suggests that in the high group, the difference between their performance on the neutral and valued forms was no different than the low group's performance differences between the neutral and valued forms.

Content Area

Table 5 shows the number of errors on each logically comparable item across all three forms, and the content area of that item on the valued form. For example, number 1 dealt with belief in god; there were 8 errors on the valued item, 1 error on the
Table 4
Analysis of Variance Summary Table for a 2 By 2 Factorial Design with Repeated Measures on the A Dimension

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1</td>
<td>20.0508</td>
<td>20.0508</td>
<td>6.43*</td>
</tr>
<tr>
<td>S&lt;sup&gt;b&lt;/sup&gt;</td>
<td>30</td>
<td>93.44329</td>
<td>3.1144</td>
<td></td>
</tr>
<tr>
<td>Within Subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1</td>
<td>17.83665</td>
<td>17.83665</td>
<td>23.6268**</td>
</tr>
<tr>
<td>AB</td>
<td>1</td>
<td>.8366</td>
<td>.8366</td>
<td>1.1082</td>
</tr>
<tr>
<td>AS</td>
<td>30</td>
<td>22.6477</td>
<td>.7549</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Factor B = high and low groups on symbolic form.

<sup>b</sup> Factor S = subjects.

<sup>c</sup> Factor A = form type.

*<sup>p</sup> < .05

**<sup>p</sup> < .01
Table 5
Number of Errors Across Equivalent Items\textsuperscript{a} on all
Forms and Content Area of Valued Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Form S</th>
<th>Form N</th>
<th>Form V</th>
<th>Content Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>Belief in god</td>
</tr>
<tr>
<td>2.</td>
<td>4</td>
<td>11</td>
<td>12</td>
<td>Rape</td>
</tr>
<tr>
<td>3.</td>
<td>8</td>
<td>7</td>
<td>12</td>
<td>Abortion</td>
</tr>
<tr>
<td>4.</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>Homosexuality</td>
</tr>
<tr>
<td>5.</td>
<td>24</td>
<td>22</td>
<td>18</td>
<td>Homosexuality</td>
</tr>
<tr>
<td>6.</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>Sexual Response</td>
</tr>
<tr>
<td>7.</td>
<td>4</td>
<td>4</td>
<td>10</td>
<td>Racial Prejudice</td>
</tr>
<tr>
<td>8.</td>
<td>1</td>
<td>3</td>
<td>12</td>
<td>Belief in god</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Forms N and V are reordered so that equivalent questions across all three forms are comparable.
neutral item, and 2 errors on the symbolic item. The direction of increasing number of errors from the symbolic to neutral to valued forms is the same for seven of eight items. Only item 5 had this directionality reversed.

Summary

The analysis of variance for a 3 by 6 factorial design with repeated measures yielded a significant main effect of form type. Neither form order nor the interaction of form order by form type was significant. Post hoc comparisons, using the Scheffé method, on the differences among the form type means resulted in significant differences between the valued form and both the neutral and symbolic forms. The neutral and symbolic forms did not significantly differ from each other. Further post hoc analyses yielded a non-significant interaction effect between blocked high-low groups on the symbolic form and performance on the neutral and valued forms. In seven of the eight equivalent cross form items, the directionality of increasing number of errors went from symbolic to neutral to valued form.
CHAPTER 5

Discussions and Conclusions

The general objective of this study was to describe the relationship between ability in deductive thinking and certain types of problem situations. More specifically, the effects of emotive content on logical analysis was observed. The subjects for this experiment were university students trained in logical, deductive reasoning. The types of problems ranged from the abstract, symbolic mode, through a relatively neutral, low emotive, verbal mode, to a highly emotive, value loaded mode. For each problem on the symbolic form, there was an exact duplicate in terms of logical analysis on the other two forms.

As the analysis of variance indicates, the same subjects performed significantly different on the value problems as compared to the other two types of problems (which did not differ from each other). This indicates support for the major hypothesis of this study. Since the application of strategies acquired in training did not seem to occur to any great extent when highly emotive material was used as a stimulus, the possibility of applications to situations that are closer to real life situations is doubtful. This decrease in performance on value problems can be attributed to lack of use of logical structures, which are available, as demonstrated by the subjects performance on the
neutral and symbolic forms.

The design of the experiment was devised to control for a variety of possible sources of variance. The order of having the tests was randomly assigned and proved to be not significant. The variance of the interaction effect between form order and form type was not significant. In the construction of the test forms N and V, wordiness was controlled for. As well, since the mean scores on the symbolic and neutral forms did not significantly differ from each other, the use of words as opposed to symbols did not contribute significantly to the variance. Post hoc comparisons of high and low symbolic performance groups yielded non-significant interaction effects. Thus, this statistical analysis showed little differential training effects for these two groups of students.

An analysis of the number of errors on each equivalent item across forms showed interesting trends. On seven of the eight items the number of errors was larger for the valued item than for the equivalent neutral and symbolic item. Item 5 showed opposite directional results, possibly due to the difficulty of this item on the symbolic form. All topic areas seemed to have a certain effect, although no statistical analyses were done. The notion of the socially acceptable conclusion versus the validity or invalidity of an argument is an area for future consideration. For example, the item on rape had a socially unacceptable conclusion (therefore,
John has motive to rape), while the argument is a valid one. Larger number of items per content area, control for social acceptability of conclusions, and individual subject's attitude variations are all topics for further research.

**Educational Implications of this Study**

It is reasonable to assume that the major differences in performance can be attributed to lack of deductive thinking on the value questions, that is, not due to inability but rather due to change in approach. The specific nature of the problem determines the manner of attempting to resolve that problem. For these students, training in deductive reasoning does not aid them in rationally arriving at logical decisions on value problems because other factors are operating. In many ways this simulates the real life attempts at problem solving, and the inadequacies in strategies and techniques used for handling these problems. Questions arise as to what is the nature of thought in these situations, as well as what are the educational implications of these results?

If transfer of learning to non-academic situations is a viable goal of education, then research and development must lend itself to the realities of everyday life situations. Of critical importance to this discussion is the view of Smith (1963) as he
relates his reasons for stressing the logical mode in education. He states that teachers work with words and statements, their meanings and relations. The teacher deals with signs and symbols and the logical operations necessary for verbal instruction. They do not work with such psychological processes as perception, emotion, inference, and conception, even though they may be going on at the same time as instruction. Smith concludes that the superior teacher will be one who understands logic and can teach his students through a logical system.

The development of an excellent logical system in an individual is a part of the function of education, not the entire function. It would be unwise to neglect processes like emotion and perception and consider them as secondaries in the education of any individual. Onceagain, this study has attempted to clarify and specify the inadequacies of logical systems in certain situations. Hart (1975) expresses a general view of all schooling, and much of adult life as worshipping rational, symbolized and verbalized modes of thought at the expense of natural thought processes. De Bono (1972) states that most people in education continue to assume that excellence in logic is all that is needed in thinking, yet the importance of "perceptual thinking" is being purposely avoided. Perhaps the strongest statement of this nature comes from Sperry (1975), the neurologist who first discovered the split brain phenomenon.
Our educational system and modern society in general (with its very heavy emphasis on communication and on early training in the three Rs) discriminates against one whole half of the brain -- the non-verbal, non-mathematical minor hemisphere, which has its own perceptual, mechanical, and spatial mode of apprehension and reasoning. In our present school system the attention given to the minor hemisphere of the brain is minimal compared with the training lavished on the left hemisphere.

(Sperry, 1975, p. 33)

Although highly speculative, recent neuropsychological and physiological research in the area of lateral specialization of hemispheric functioning may affect educational outlooks (Gazzaniga, 1970; Luria, 1973; Gardner, 1974; Hart, 1975; Sperry, 1975). These results are far from conclusive as yet, but have suggested that a large part of our brain is concerned with other than logical operations. The right side of the brain appears to perceive things in a relational manner, not as parts but as simultaneous wholes. In certain problem situations there are differences in useable mental strategies according to the particular manner of the problems. If this is true, then educational procedures, as Sperry notes, may in fact be excluding the training of vast areas of the brain.
This paper has specifically focused on one segment of schooling, values education, and has attempted to empirically test that emphasis on sequential, deductive logic and thought is possibly not compatible with the educational objective of transfer of learning to life like situations. In this experiment the data appear to support the notion that ability in logic is insufficient by itself for the solution of simple value problems. The reasoning of Smith and those previously mentioned who stress the logical, sequential mode of thought is not entirely reasonable for the development of educational programs to aid the individual in value situations. Stress on cognitive, critical abilities is only one area of education and other modes and processes cannot be excluded. The impact of emotion, perception, inference, relationships, non-verbal communication, and affective functioning cannot be isolated from the school environment if transfer of learning is to be a realistic educational objective.
Reference Notes


References


I am interested in finding out how you, individually, respond to a variety of questions. I would like to know your personal opinions in certain situations. Therefore, all information that I receive will be anonymous and confidential. Your responses on these questions are in no way associated with course grades. Your help in answering all the questions as honestly as possible will be greatly appreciated.
Form S

Personal Opinion Questionnaire

In this questionnaire I am interested in your personal opinions and beliefs regarding the following questions. Each question is presented as a particular argument. Is it your personal opinion that the following arguments are either valid or invalid?

Space is provided beside or on the backside of each question for any specific comments that you might want to make regarding your decisions.

In the following arguments, is it your personal opinion that they are either valid or invalid? (Circle your personal choice).
1. \[(P \land Q) \implies R\]
\[(P \land Q)\]
\[\therefore R.\]
Valid \hspace{1cm} Invalid

2. \[P \implies Q\]
\[Q \implies R\]
\[P\]
\[\therefore R.\]
Valid \hspace{1cm} Invalid

3. \[P \implies Q\]
\[\neg P\]
\[\therefore \neg Q.\]
Valid \hspace{1cm} Invalid

4. \[P \implies \neg Q\]
\[Q\]
\[\therefore P.\]
Valid \hspace{1cm} Invalid
5. \((P \lor Q) \supset R\)
   \(\therefore \neg R \supset \neg P\).
   
   Valid    Invalid

6. \(P \supset R\)
   \(R \supset S\)
   \(S\)
   \(\therefore \neg P\).
   
   Valid    Invalid

7. \(P \supset Q\)
   \(R \supset \neg S\)
   \(R \supset \neg Q\)
   \(P\)
   \(\therefore \neg S\).
   
   Valid    Invalid

8. \((P \land Q) \supset R\)
   
   \((P \land Q)\)
   \(\therefore \neg R\).
   
   Valid    Invalid
I am interested in finding out how you, individually, respond to a variety of questions. I would like to know your personal opinions in certain situations. Therefore, all information that I receive will be anonymous and confidential. Your responses on these questions are in no way associated with course grades. Your help in answering all the questions as honestly as possible will be greatly appreciated.
Personal Opinion Questionnaire

In this questionnaire I am interested in your personal opinions and beliefs regarding the following questions. Each question is presented as a particular argument. Is it your personal opinion that the following arguments are either valid or invalid?

Space is provided beside or on the backside of each question for any specific comments that you might want to make regarding your decisions.

In the following arguments, is it your personal opinion that they are either valid or invalid? (Circle your personal choice).
1. If John plays baseball and comes home late he will not study for his upcoming exam. John plays baseball and does come home late. Therefore, he will not study for his upcoming exam. 

   Valid     Invalid

2. If in November it mainly rains, then there will be few sunny days. If there are few sunny days, then the mountains are hidden from view most of the time. Since we know that the mountains are hidden from view most of the time, then we can assume that in November it mainly rains.

   Valid     Invalid

3. If the cat on the roof jumps, she will land on her feet. Either the cat is black or she is not a Persian. If the cat is black then she will not land on her feet. It is a fact that the cat on the roof jumped. Therefore, she is Persian.

   Valid     Invalid

4. If I work through this problem quickly or if I daydream, then the time will pass equally fast. If it is not the case that the time will pass equally fast then it is not the case that I worked through this problem quickly.

   Valid     Invalid
5. If the sun is shining and the wind is blowing then I will be whistling a tune. The sun is shining and the wind is blowing. Therefore, I will be whistling a tune.

Valid    Invalid

6. If this ball is brown, then this square is blue. This ball is not brown. Therefore, this square is not blue.

Valid    Invalid

7. If in the town where I was born there lived a man who sailed the seas, then he told me of his life in a yellow submarine. If he told me of his life, then we all live in a yellow submarine. It so happens that in the town where I was born there was a man who sailed the seas. Therefore, we all live in a yellow submarine.

Valid    Invalid

8. If the banjo has five strings, then you cannot hear the piano. But you can hear the piano. Therefore, the banjo has five strings.

Valid    Invalid
Form V

I am interested in finding out how you, individually, respond to a variety of questions. I would like to know your personal opinions in certain situations. Therefore, all information that I receive will be anonymous and confidential. Your responses on these questions are in no way associated with course grades. Your help in answering all the questions as honestly as possible will be greatly appreciated.
In this questionnaire I am interested in your personal opinions and beliefs regarding the following questions. Each question is presented as a particular argument. Is it your personal opinion that the following arguments are either valid or invalid?

Space is provided beside or on the backside of each question for any specific comments that you might want to make regarding your decisions.

In the following arguments, is it your personal opinion that they are either valid or invalid? (Circle your personal choice).
1. If homosexuality is a mental illness or if homosexuals need psychiatric help, then offenders should be institutionalized. Therefore, if it is not the case that offenders should be institutionalized then it is not the case that homosexuality is a mental illness.

Valid Invalid

2. If homosexuals ought to be able to marry, then they can be satisfied human beings. If they can be satisfied human beings, then we should no longer ostracize them. Actually we should no longer ostracize homosexuals, so therefore, they ought to be able to marry.

Valid Invalid

3. If a two month old foetus has a heart, eyes, and a functioning nervous system, then it is killing a human life to destroy it. It is not the case that a two month old foetus has a heart, eyes, and a functioning nervous system. Therefore, it is not killing a human life to destroy it.

Valid Invalid
4. If the number of East Indians coming to Canada is controlled, then there will be more jobs for Canadians. Either East Indians must work in the north for five years or they must not be allowed to come to Canada. If East Indians work in the north for five years then it is not the case that there will be more jobs for Canadians. Since it is a fact that the number of East Indians coming to Canada is controlled, therefore, East Indians should be allowed to come to Canada.

Valid  Invalid

5. In 1972, in the Andes Mountains, a plane crashed onto an empty snowfield. There were sixteen survivors left amid the wreckage and the other bodies. After initial emergency supplies ran out, there was nothing else to eat except the bodies of the dead. Starvation was imminent.

If you believe in god and that to sanctify the spirit you must bury the dead, then you must die. You believe in god and the sanctity of the spirit. Therefore, you must die.

Valid  Invalid

6. If you believe in god and that to sanctify the spirit you must not let yourself die, then you must not die. You believe in god and the sanctity of the spirit. Therefore, you must not die.

Valid  Invalid
Form V

7. If Anne is hitchhiking braless, in a see-through blouse, she is being suggestive to rape. If she is suggestive to rape, then John has motive to rape. One day John sees Anne hitchhiking braless in a see-through blouse. Therefore, John has motive to rape.

Valid  Invalid

8. If you are at least an adequate person, then you will not reach orgasm in every single sexual encounter. But you are reaching orgasm every single time. Thus, of course, you are at least adequate.

Valid  Invalid
Appendix B

This is a summary of the verbal instructions which were given to the subjects prior to the administration of the test measures.

The examiner introduced himself and thanked the professor and students for consenting to give up their time for this experiment. The students were told that there would be three sessions in total. The examiner described his area of interest as individual differences in problem solving. He stated his interest in the students' personal beliefs and opinions on a variety of questions. The questionnaire was to be completely anonymous and confidential, and the students' complete honesty based on their personal outlooks was requested.

It was mentioned that this had nothing to do with class grades. On the questionnaires, the students were told not to rush through the questions, but if any proved too difficult to go on to the next question. They were told not to spend too much time on any one question and to hand in their paper and leave when they were finished.

Most importantly, they were requested not to speak amongst themselves about these questionnaires until after the three testing sessions were completed.

The questionnaires were then handed out and the testing session proceeded for twenty minutes.