THE INFLUENCE OF DOGMATISM AND RIGIDITY

ON REASONING

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

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1964

THE INFLUENCE OF DOGMATISM AND RIGIDITY ON REASONING

ABSTRACT

To test the relationship between synthesis and analysis and induction and deduction with dogmatism and rigidity, Rokeach's Dogmatism Scale and the Gough-Sanford Rigidity Scale was administered to 341 undergraduates at Michigan State University. The 20 students scoring highest and the 20 students scoring lowest on the Dogmatism Scale were selected for individual testing. Both groups of subjects were further divided into two groups of ten each on the basis of their scores on the Rigidity Scale.

The first task consisted of a set of twenty-five analogies emphasizing induction, and another set of analogies emphasizing deduction. The subject's performance on this task was measured in terms of the relative amount of time spent on the preparation period of the problem and on the solution phase of the problem as well as the number of errors made. The second problem was the Denny Doodlebug Problem with separate measures of analysis in terms of the time required to overcome the beliefs of the problem and the number of beliefs the subject could overcome by himself, and synthesis measured in terms of the number of minutes required to solve the problem after each of the beliefs was overcome.

The general conclusions of this study are that: (1) in a problem solving situation in which the primary task of the subject is to integrate various beliefs of component

parts of the problem open subjects are superior to closed

subjects; (2) in a problem solving situation in which the

task of the subject is to analyze or discover the parts

of the problem, non-rigid subjects are superior to rigid

subjects; (3) there is a tendency for subjects who excel

in synthesis to also excel on inductive reasoning; (4)

there is a tendency for subjects who excel in analysis

to do well on problems emphasizing deduction.

Approved _Milton Rokeach_

Date _May 25, 1964_

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AND RIGIDITY ON REASONING

by

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A THESIS

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

MASTER OF ARTS

Department of Psychology

1964

ERRATA

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Table XIII.   Mean Solution Time for the Denny Doodlebug
              Problem Following the First, Second, and
              All Three Beliefs.

Group	First Belief	Second Belief	All Three Beliefs
High Dogmatism-High Rigid	21.83	15.95	8.65
High Dogmatism-Low Rigid	28.36	24.48	14.94
Low Dogmatism-High Rigid	19.22	12.95	5.19
Low Dogmatism-Low Rigid	11.31	8.31	1.86
High Dogmatism	25.095	20.215	11.795
Low Dogmatism	15.265	10.630	3.525
High Rigid	20.525	14.45	6.920
Low Rigid	19.835	16.395	8.400

Page 39   Chi Square = .226

Page 40   Chi Square = 1.434,   p less than .15 one tailed test

Page 41   Chi Square = 1.096,

Page 42   Chi Square =   .510

Page 44   p less than .70

Page 44   Chi Square = .083, p less than .80

Page 50   In Table XXXIV, the time taken to solve the Doodlebug
          Problem after all three beliefs had been overcome for
          the Nonrigid group = 2.6

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THE RELATIONSHIP OF DOGMATISM AND RIGIDITY ON REASONING

There is a general distinction made by psychologists and others interested in the study of problem solving and the process of thinking between reasoning from a part to a whole, and reasoning from the general to the particular. The former frequently is referred to as inductive reasoning and the latter as deductive reasoning. Clarke, for example, states that "The term logic. . .is usually employed in a more restricted sense. . .means either the process of making generalizations (inductive logic), or the process of drawing from assumptions inferences which are implicit in them but which are not obvious (deductive logic)(1929, p. 77)." Similarly, Miller differentiates between the two forms as follows, "Deduction is that form of thinking in which an individual (case) which is problematic is interpreted and controlled by referring it to some concept, or law, which is, for the time being at least unquestioned. Induction is that form of thinking in which a concept or law, which has become problematic, is reconstructed through an investigation and analysis of individuals." (1915, p. 233) More recently Vinacke describes the same two processes as: "Deduction, crudely defined, is reasoning from the general to the particular, or, more specifically, from stated premises to a proper conclusion; induction, similarly, signifies reasoning from the particular to the general." (1952, p. 76) The

distinction between induction and deduction appears to be primarily linked to the nature of the problem more than in the person attempting to solve the problem. If the problem is one which requires the application of a known principle or generalization to a specific case, then the thought process is deductive. If the problem is one for which an example has been provided and the problem solver must find the general rule which is operating, the reasoning is inductive.

The question then arises whether there are individual differences in problem solving which are specific to the kind of problem being worked upon or are persons who are capable of one kind of reasoning also capable of the other equally well? Further, if there are individual differences with respect to the ability to solve inductive or deductive problems, what other variables are associated with these individual differences? One technique which was employed to study such relationships was factor analysis. Of the factor analytic studies on problem solving which attempted to separate these two functions, the results have not been conclusive. Thurstone factor analyzed 57 tests taken by 250 college students and identified an induction factor, a restrictive thinking factor, and a deduction factor (1938). However, a similar factor analysis of 60 tests taken by 710 eighth-graders found only the induction factor (Thurstone and Thurstone, 1941). Additional factor analytic studies by Holziner and Harman failed to confirm the separation of inductive and deductive reasoning

(1938). One of the most complete studies of reasoning
using the method of factor analysis is that done by
Guilford and others at the University of Southern
California (Guilford, Comrey, Green, and Christensen,
1950; and Guilford, Green, and Christensen, 1951). It
was hypothesized that the ability to grasp a system of
relationships in its totality, or to see trends in a
series of objects, to identify a relationship in a
variety of settings would constitute inductive reasoning
ability. The reasoning ability tested in syllogisms was
felt to be deduction. Factor analysis of 34 tests of
283 subjects identified a general reasoning factor of
prime importance while deductive reasoning was found in
tests of reasoning, inference, syllogisms, and false
premises, but the tests which were used to define this
factor were multiple-choice and true-false form. No
general induction factor was identified.

Another approach has been to analyze the process
of problem solving into various phases. Dewey described
five such separate stages in the problem solving sequence
as follows: "(i) a felt difficulty; (ii) its location
and definition; (iii) suggestion of possible solution;
(iv) development by reasoning of the bearings of the
suggestion; (v) further observation and experiment
leading to its acceptance or rejection; that is, the
conclusion of belief or disbelief." (1910, p. 72) From
such an analysis of the problem solving process it is
possible to formulate different methods of studying

the reasoning process. First there is the possibility

of constructing problems in which the various phases may

be measured separately, such that an objective record may

be made as the problem solver passes through each successive

phase. Another alternative which is also based on the

analysis of the problem solving process into its component

parts consists of constructing problems in which the diffi-

culty of the problem lies primarily in one phase. Perfor-

mance on this kind of a problem may be compared with

performance on another problem for which the difficulty

lies in some other phase.

One of the major benefits of using a method based on

the analysis of the parts of the problem solving process

into separate phases is that it is possible to take into

account the fact that in most problem solving behavior,

both an inductive and a deductive operation are involved.

Johnson in referring to problems of logical relations

states that:

>"Forming concepts, principles, and patterns
of personality traits may be called inductive tasks
in that the particulars are organized into patterns...
But we do not observe these cognitive patterns di-
rectly; we test for the pattern by asking the thinker
to use it in some particular way, that is, by a de-
ductive process...problems that are called deductive,
e.g., the syllogism, always include an inductive step
because the particulars of any problem have to be
organized before any conclusions can be produced."
(1955,p. 243)

Following Dewey's analysis of the problem solving

process, reason may be thought of as the solution of problems

by logical operations. More specifically, the operations
which the reasoner goes through in order to solve a par-
ticular problem may be thought of as follows: first, the
reasoner organizes the problem situation and the wanted
solution as well as he can. He then produces responses
and finally judges the acceptability of these responses.
Induction is the process of organizing the particulars of
the problem situation into a conceptual pattern. An in-
ference is of the form: If thus and so then _____.
Deduction is the process of fitting a solution pattern
to the inference thus organized. It is reasonable to
assume that individual differences may be found at any
point in the sequence of logical operations. Consider
the following analogy:

      large is to small as expensive is to _____
      fine, post, run, time, cheap

First the relationship between large and small
must be discovered. Second, _expensive_ must be placed
into this relationship with a place for the other term.
Third, the reasoner tries out the offered solution words
to see which one best fits the search model. If a measure
of deductive ability is desired, it is necessary to con-
struct items in which the third step is suffiently diffi-
cult that some will fail at this point, while steps one
and two are so easy that everyone will be successful at
these points. If a measure of induction is desired, it

is necessary to construct items such that some will fail
on the first step, that is in establishing the relationship,
while there should be relatively little difficulty in steps
two and three. (Johnson, 1955, pp 306-7)

Johnson, in an attempt to study the determinants of
preparation time, constructed a block of 25 analogies
with the first pair of words more difficult than the
second pair, hence emphasizing induction. Another block
of 25 analogies was constructed with the second pair of
words more difficult than the first pair, emphasizing de-
duction. Using a technique of serial exposure of the
analogies, he found in comparing preparation time between
the two types of analogies that log mean preparation time
was greater for the analogies emphasizing induction, and
log mean solution time was greater for those emphasizing
deduction. Similarily, a time index of relative difficulty
of preparation differentiated the two types of problems
significantly (Johnson, 1960).

In further investigation of the method of serial
analysis of inductive and deductive reasoning using various
formats for the presentation of the analogy, the preparation
index, obtained by dividing preparation time by the total time
to get the proportion of the whole time that is spent on
the first period, differentiated inductive from deductive
problems thus supporting in general the distinction between

these forms of reasoning, and the use of serial presentation of verbal analogies as a technique for studying these different processes (Johnson, 1962).

While the technique of comparing performance on different problems which emphasize different phases of the reasoning process has been useful in the study of the problem solving, a number of studies have been done in which comparisons were made between the subjects' performance on different phases of the same problem. This has been one of the ways in which Rokeach has attempted to study the distinction between open and closed subjects. In discussing the Doodlebug Problem he states that one of the reasons the problem is so difficult is that "the subject must first overcome not one but three currently held beliefs, and replace them with three new ones. This is the analytic phase of the problem. . .He must then organize them together, or integrate them into a new system. This is the synthesizing phase of the problem." (Rokeach, 1960, p. 173) The Problem is constructed so that it is possible to obtain five separate measures of the thinker's ability to analyze, all of which test in one way or another how long it takes the thinker to overcome the separate beliefs of the problem. Synthesis refers to how fast the thinker can integrate new beliefs into a new belief system. When the thinker finally states the solution to the problem, it is the end result of a prior process of synthesizing activity. In the Doodlebug Problem,

there are three separate measures of synthesis or inte-
gration.

Another dimension in which the distinction between
analysis and synthesis is profitable is in the study of
perceptual tasks. Witkins and others have indicated that
people differ in the extent to which their perception is
analytical. This dimension of individual differences
has been called "field-dependence-independence." The
tendency toward an analytical or global way of perceiving
characterizes a person's perception in a wide variety of
situations, making for marked individual self-consistency.
(Witkin et. al. 1962, p. 58). The implication would appear
to be that differences in analytic and synthetic thinking
are general personality factors which are related to a
number of other variables. From what has been mentioned
above concerning individual differences in inductive and
deductive reasoning ability, it might be reasonable that
such differences would also be related to some general
personality dimensions. One of the earlier personality
variables which seemed to be related to a person's ability
to reason was authoritarianism as measured by the F scale.
Analysis of the ideological as well as the clinical material
has suggested that ethnocentrism is related to stereotypy,
rigidity, and concreteness in thinking (Adorno et. al. 1950,
p. 280). Rokeach, in an attempt to expand the measurement
of authoritarianism to general authoritarianism developed
the Dogmatism scale which tested for general authoritarianism

of both the right and the left (Rokeach, 1960). With
respect to the ability to solve abstract problems, Rokeach
differentiates between the difficulties which arise due to
the subject's resistance to change belief systems which is
measured by the Dogmatism scale, and difficulties which are
primarily due to the subject's resistance to change a single
belief as measured by a Rigidity scale such as that of Gough
and Sanford (1952).

The referent of dogmatic thinking is within a total
cognitive framework of ideas and beliefs organized into
a relatively closed system; while rigidity refers primarily
to the difficulties in overcoming single sets or beliefs
encountered in attacking, solving, or learning specific
tasks or problems (Rokeach, 1960, p. 183). This dis-
tinction between Dogmatism and Rigidity has been related
to the above mentioned distinction between analysis and
synthesis by Rokeach and others (1955). Persons who
score high on Dogmatism have difficulties with synthesis,
while persons who score high on Rigidity have greater
difficulty in analysis. These results have been replicated
using the entire range of scores on the dogmatism scale
(Fillenbaum and Jackman, 1961), although certain aspects of
the problem used to test these differences, namely the order
of presentation of the hints used in the Denny Doodlebug
problem have been questioned (Lyda, L. and Fillenbaum, 1960),
indicating that the construction of the problem used is of
great importance. The differences found between open and
closed subjects who were either high or low on rigidity has

not only been found to operate on conceptual problems such
as the Denny Doodlebug problem, but has also been related
to perceptual problems following Witkin (1950). Rokeach
and Levy designed problems for which separate measures of
analysis and synthesis in perception were possible which
were found to be related to dogmatism and rigidity. (Rokeach,
1960) Similarly, Huberman has reported differential behavior
of extremely high and low dogmatic subjects on certain Kohs
block tasks (1961).

After having found dogmatism and rigidity to be re-
lated to analysis and synthesis in cognition and in per-
ception, it would seem profitable if deductive and inductive
reasoning could be related to analysis and synthesis. Upon
examination of the processes which are measured by Johnson
(1962) it is apparent that those problems which emphasize
deduction do so by making it difficult for the subject to
apply a general rule while in the inductive problems, it is
difficult to produce the general rule or to state the re-
lationship for which the two words presented are examples.
The process of deduction is similar to analysis in that the
subject is required to break the existing structure of the
problem into its component parts in order to determine
which of the alternatives offered indeed fits as a part
in the relationship, and which of the alternatives do not.
Induction and synthesis if not altogether the same process
at least share the common feature in that they are both
concerned with putting the various parts of the problem
together, or taking what has already been given

the various parts of the problem. Rokeach, in speaking

about the distinction between these two interrelated

aspects of cognitive functioning states:

> "There are many ways of talking about these two
> aspects: the resistance to change of systems of
> beliefs; rigidity and dogmatism; the analysis
> phase and the synthesis phase in thinking and
> perceiving; the overcoming of sets and the inte-
> gration of sets; the separation of an item from
> a field and its reconstruction into new fields.
> Perhaps we are also dealing with the process of
> deduction and induction." (Rokeach, 1960, p. 289)

If the above description of Johnson's measures of

deduction and induction as being similar to analysis

and synthesis in which the subject must make a judgment

concerning a relationship between concepts holds true,

then rather specific hypotheses may be formulated re-

garding the relationship between dogmatism with synthesis

and induction and of rigidity with analysis and deduction.

It is to be expected that those persons classified as

dogmatic, that is resistant to change of belief systems,

should have greater difficulty solving problems empha-

sizing induction than persons classified as open or less

resistant to change of belief systems. Further, it is

anticipated that those persons who are classified as being

rigid should have greater difficulty in solving problems

emphasizing deduction than would persons classified as

being more flexible. Third, it is expected that the ability

to do well on problems emphasizing deduction should be re-

lated to analysis as measured by the Denny Doodlebug problem.

Similarly, it is expected that the ability to do well on

problems emphasizing induction should be related to the

ability to do well on conceptual synthesis.

Hypotheses. The specific hypotheses of this study are
              as follows:

A. Concerning induction:
   1. The open group should solve inductive problems with
      fewer errors and faster than the closed group.
   2. The rigid group should not differ from the non-rigid
      group with respect to this variable.

B. Concerning deduction:
   1. The open group should not differ from the closed
      group with respect to this variable.
   2. The rigid group should make more errors and take more
      time to solve problems emphasizing this variable than
      should the non-rigid group.

C. Concerning synthesis:
   1. The open group should be faster than the closed group.
   2. The rigid group should not differ from the non-rigid
      group with respect to this variable.

D. Concerning analysis:
   1. The open group should not differ from the closed group
      on this variable.
   2. The rigid group should be slower and discover fewer of
      the beliefs without outside help than the non-rigid
      group.

E. The relationship between analysis and deduction should
   be demonstratable in that those who do well on analysis
   should also do well on deduction.

F. The relationship between induction and synthesis should
   be such that those who do well on synthesis should also
   do well on induction.

Population. The subjects used in the experiment came from a population of over 300 students enrolled in either introductory psychology, education, or political science at Michigan State University during the summer of 1963.

Dogmatism Scale. The degree of openness-closedness for each individual was measured by Rokeach's Dogmatism Scale Form E[1] which can be found in the Appendix. The Dogmatism Scale (40 items) along with the Gough-Sanford Rigidity Scale (22 items) and 24 "filler items" scattered throughout the scale to disguise its purpose was administered to the students in a classroom setting. To each of the questionnaire statements the subjects responded indicating how strongly they agreed or disagreed by means of the following scale: +1 = I agree a little, +2 = I agree on the whole, +3 = I agree very much, -1 = I disagree a little, -2 = I disagree on the whole, -3 = I disagree very much. The subjects were informed that the questionnaire was part of a larger study and that they might be contacted later. The subjects were told before the questionnaire was passed out that if they did not wish to participate they could leave, although none of the students did in fact leave. The following instructions were printed at the top of the questionnaire:

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[1]For a full discussion of the construction of this scale, see Rokeach (1960).

Rigidity Scale. The degree of flexibility in the ability to change single beliefs was measured by the Gough and Sanford Rigidity Scale which was mixed in with the Dogmatism Scale. The items of this scale can be found marked Rigidity in the Appendix. The instructions for the entire questionnaire were the same for all questions, subjects indicating strong agreement with the item by marking +3 and indicating strong disagreement with the item by marking -3. The referents in this scale are for specific tasks or habits rather than total belief systems.

Rokeach has pointed out that dogmatic and rigid thinking are discriminable processes not necessarily independent processes. The correlation between the Dogmatism and Rigidity Scales ranges from .37 to .55. (Rokeach, 1960, p. 193). The correlation between the Dogmatism and Rigidity Scales for the subjects used in this experiemnt was .7 which is artificially high due to the process by which the subjects were selected for the experiment. The fact that these are two discriminably different processes has been supported by the results of two factor analyses, both indicating that the Dogmatism and Rigidity Scales are measuring essentially independent psychological dimensions (as reported in Rokeach, 1960).

Subjects. Twenty students with the highest scores and twenty students with the lowest scores on the Dogmatism Scale were asked to come into the laboratory for individual

testing. They were told that they had been selected on
a random basis in an attempt to know something more
about the general population of students who were
given the questionnaire in class. Three of the high
scorers and two of the low scorers were not available
for individual testing either because they were only
attending the first five weeks of the summer session,
or refused to make an appointment for individual test-
ing. These were replaced by the students with either
the next highest or lowest score. The two groups were
then further divided into high and low scorers on the
Rigidity scale. The subjects were selected in a way such
that the experimenter did not know which of the resulting
four groups the subject belonged to until after the in-
dividual testing was completed.

To avoid dealing with negative scores, a constant
of 160 was added to the Dogmatism score after algebrai-
cally summing the responses. Hence, scores on the
Dogmatism Scale could range from +40 for complete dis-
agreement with each statement to +280 for complete agree-
ment to all statements. The range actually obtained was
from +86 to +199.

As indicated in Table I below, low scorers on
Dogmatism differ on the average about 62 points from the
high dogmatic scorers. Low scorers on Rigidity differed
from high scorers on the average of slightly under five
points on dogmatism.

Table I--Comparison of Means and Standard Deviations of
        the Dogmatism Scale

Group	N	Mean	Std. Dev
High Dogmatism--High Rigidity	10	182.7	11.186
High Dogmatism--Low Rigidity	10	177.8	8.108
Low Dogmatism--High Rigidity	10	120.2	13.315
Low Dogmatism--Low Rigidity	10	115.5	12.421
High Dogmatism--combined	20	180.25	9.835
Low Dogmatism--combined	20	117,85	12.762
High Rigidity--combined	20	151.45	34.223
Low Rigidity--combined	20	146.65	33.550

The scores on the Rigidity Scale were treated in
a similar fashion in that a constant of 88 was added
to each score to avoid dealing with negative scores.
The possible range of scores after the constant has
been added is from +22 to +154, although in the sub-
jects tested the obtained range was from +57 to +120.
Table II below indicates that low dogmatic subjects
differ from high dogmatic subjects on the average of
about 17 points. Low scorers on Rigidity differ from
high scorers on the average of approximately 23 points.
Thus the precedure was successful in separating the
groups on Rigidity but the relationship between the
Dogmatism and the Rigidity scorers is also quite strong.

Table II--Comparison of Means and Standard Deviation
on the Rigidity Scale

Group	N	Mean	Std. Dev.
High Dogmatism--High Rigidity	10	109.6	6.168
High Dogmatism--Low Rigidity	10	86.7	7.959
Low Dogmatism--High Rigidity	10	92.2	7.800
Low Dogmatism--Low Rigidity	10	69.6	8.972
High Dogmatism--combined	20	98.15	13.639
Low Dogmatism--combined	20	80.90	14.190
High Rigidity--combined	20	100.90	11.248
Low Rigidity--combined	20	78.15	12.045

Procedure. In the individual testing situation, the
students were given two kinds of problems to solve. First
the subjects worked on a set of analogies emphasizing
induction and deduction. . After having completed
all of the analogy problems, the subjects were presented
with the Denny Doodlebug problem in an attempt to obtain
a measure of conceptual analysis and synthesis.

For the first set of problems, the subjects were
asked to solve 50 analogy problems 25 of which were con-
structed with the emphasis on induction and 25 of which
with the emphasis on deduction, all 50 were given in an
irregular order. The material was divided into two parts
and exposed serially behind a half-silvered mirror. The
preparation exposure consisted of the first pair of words.
The second exposure included the first word of the second
pair and five numbered words as alternative solutions.

Both exposures were controlled by the subject and timed electrically. When the subject finished studying the first pair of words, he turned a switch which turned off the first exposure and turned on the second. He then chose one of the solutions and pressed one of the five numbered buttons, thus registering his choice and ending the second exposure. Each subject received a score for **induction and deduction.** based on his performance on the total set of problems emphasizing analysis and synthesis. The scores recorded were: the time spent on the first part of the problem referred to as the preparation period; the time spent on the second part of the problem or the solution time; and the number of errors made on each set of problems, in terms of the number of incorrect solutions.

Apparatus. The serial-exposure box consists of two chambers separated by a partition and separately lighted. The side toward the subject includes a half-silvered mirror about 7 x 9 inches, and on the back side is a holder for 5 x 8 cards positioned so that when the light in the left chamber is turned on only the left half of the card is visible. Similarly, when the right chamber is lighted, only the right half of the card is visible. The verbal analogy is presented on a card as follows:

			1. fine
			2. post
large	small	expensive	3. run
			4. time
			5. cheap

The answer to each problem is a number from 1 to 5, which is expressed by pushing one of five appropriately labeled buttons. A system of interval timers, relays, and clocks permit the subject to view each half of the problem as long as he wishes while a record of the time spent on each part of the problem is obtained. The subject is not permitted to return to the earlier part of the problem once he has switched to the second part. The experimenter made a record of the amount of time spent on each part of every problem as well as the answer chosen by the subject. The primary assumption involved is that the subject in his effort to solve the problem operates serially on the material that is presented serially. While the material on the left half of the card is exposed to view, he has no problem to solve but is getting ready for the material presented next, that is preparation. The activity during the next period involves the selection of a solution and pressing the appropriate button to indicate the choice (Johnson, 1960).

Instructions to the subjects.

Side one:
"These problems are all in the form of analogies, such as;
    light heavy   little big
The relation between the second pair of words is the same

as the relation between the first pair. Here is another
         fire   hot   ice   ?
Your problem is to find a word that has the same relation
to ice as hot has to fire. You will search for the correct
word   in a list of five words.
The first pair of words will appear in the left side of the
box. When you have discovered the relation between them
move the toggle switch below to the right............"

Side two:
".......and look at the word and the numbered column of
words beside it in the right side. You cannot return
to the left side, so study the first pair of words before
you move the switch. When you have found the right word
push in and hold the button below with the same number
as the word of your choice."

        The subjects were then given four practice trials
to acquaint them with the procedure.
1. large   small
    expensive   1.fine 2.post 3.run 4.time 5.cheap

2. year   month
    week   1.first 2.round 3.pot 4.day 5.nine

3. Buick   automobile
    Baldwin   1.violin 2.light 3.piano 4.knife 5.calendar

4. knife   cut
    shovel   1.scratch 2.dig 3.lift 4.pour 5.sharpen

The Doodlebug Problem.

        After the subjects had completed the inductive and

deductive problems, they were asked to solve a different

kind of problem involving an imaginary bug who lives in

a world of his own. The subjects were told that the prob-

lem was not an easy one, but that there was a solution

which could be reached by good logical analysis. The

conditions of the problem, the situation, and the specific

problem were then read to the subject. After the problem had

been gone over, the experimenter asked the subject to think

aloud while he worked so that the experimenter could let

him know whether or not he was correct. The subject was.

allowed to use scratch paper and ask questions at any
time. Questions were answered by repeating the part of
the conditions, situation, or problem which were relevant
to the question. After the subject had worked for fif-
teen minutes, he was asked if he had a solution. If the
subject had no solution, or if the solution offered was
incorrect, the subject was read the first of three hints.
At the end of twenty minutes, the subject was asked again
if he had solved the problem and if not, he was given the
second hint. At the end of twenty-five minutes the sub-
ject was again asked if he had a solution for the problem
and if the subject did not have the correct solution, he
was given the final hint. The subject was then allowed
twenty minutes more to work on the problem, if he could
not solve it he was given the solution. When the subject
had either solved the problem or had been given the answer,
he was thanked for his cooperation and asked not to tell
anyone else about the problems used in the experiment
because the experimenter wished to test additional people.
During the time the subject was working on the problem,
the experimenter wrote down all questions asked and comments
made by the subject in order to determine at what time, if
at all, the subject discovered one of the hints by himself
and how he made use of the new information which was avail-
able to him at any given time. The conditions, the situation,
and the problem are given below as well as the three hints
or beliefs which the subject either discovered by himself,

or which were read to him at the specified time intervals.

The Conditions

Joe Doodlebug is a strange sort of imaginary bug.
He can and cannot do the following things:

1. He can jump in only four different directions,
north, south, east, and west. He cannot jump diagonally
(e.g., southeast, northwest, etc.).

2. Once he starts in any direction, that is, north,
south, east, and west, he must jump four times in that
same direction before he can switch to another direction.

3. He can only jump, not crawl, fly, or walk.

4. He can jump very large distances or very small
distances, but not less than one inch per jump.

5. Joe cannot turn around.

The Situation

Joe has been jumping all over the place getting some
exercise when his master places a pile of food three feet
directly west of him. Joe notices that the pile of food
is a little larger than he. As soon as Joe sees all this
food, he stops dead in his tracks facing north. After all
his exercise Joe is very hungry and wants to get the food
as quickly as he possibly can. Joe examines the situation
and then says, "Darn it, I'll have to jump four times to
get the food."

The Problem

Joe Doodlebug was a smart bug and he was dead right
in his conclusion. Why do you suppose Joe Doodlebug had
to take four jumps, no more and no less, to reach the food?

The hints which were given are as follows:

1. The facing belief. "I'm going to give you a hint: Joe does not have to face the food in order to eat it. (Repeat hint.) OK, I'll give you five minutes more."

2. The direction belief. "I'll give you another hint: Joe can jump sideways and backwards as well as forwards. (Repeat hint) I'll give you five minutes more."

3. The movement belief. "Let's read the problem again. (The experimenter reads the entire problem to the subject.) Now, here is the last hint: Joe was moving east when the food was presented. (Repeat hint) You have twenty minutes more."

Specific measures of analysis for the Doodlebug problem are as follows:

1. Time taken to overcome the first belief.
2. Time taken to overcome the first two beliefs.
3. Time taken to overcome all three beliefs.
4. Number of beliefs overcome without outside help by the time the first belief is given as a hint.
5. Number of beliefs overcome by the time the second belief is given as a hint.

Three measures of synthesis obtainable from the Doodlebug problem are:

1. Time taken to solve the problem after the first belief is overcome.
2. Time taken to solve the problem after the second belief is overcome.
3. Time taken to solve the problem after all three beliefs are overcome (Rokeach, 1960, pp. 175-176).

RESULTS

Induction.

The hypothesis that open subjects would perform better than closed subjects on the problems emphasizing induction while there would be no difference between the rigid and the non-rigid groups is supported both by a comparison of the errors made, and of the preparation index for these problems.

The superiority of the low dogmatic subjects on the problems emphasizing induction is apparent from an examination of the mean number of errors and mean preparation index. Table III below presents the average number of errors made by the subjects in the various groups. It may be seen that the closed subjects, on the average, make about two more errors than do the open subjects, while the rigid and non-rigid subjects differ from each other by less than one point.

Table III   Comparison of the Mean Number of Errors made on the Problems Emphasizing Induction.

	Mean Number of Errors made by the Rigid Groups	Mean Number of Errors made by the Non-Rigid Groups	Mean Number of Errors made by Combined Group
Closed	8.3	9.3	8.8
Open	6.7	6.9	6.8
Combined	7.5	8.1	7.8

Table IV below gives the summary table for the analysis of variance of the errors made on the 25 inductive problems.

The probability levels reported are in terms of a one-tailed test as the direction of the differences obtained had been predicted in advance.

Table IV. Analysis of Variance of the Errors made on the Problems Emphasizing Induction.

SOURCE	S.S.	d.f.	M.S.	F ratio	p
Dogmatism	40.0	1	40.0	4.81283	< .025
Rigidity	3.6	1	3.6	.43315	....
Dogmatism x Rigidity	1.6	1	1.6	.19251	....
Within	299.2	36	8.31111		
Total	344.4	39			

Table V below gives the average preparation index for the induction problems. As indicated by an analysis of variance of the preparation index for these problems, the open group has a lower preparation index on these problems indicating that they are spending relatively less time on the preparation phase of these problems.

Table V. Comparison of the Mean Preparation Index on the Problems Emphasizing Induction.

	Mean Preparation Index of Rigid Group	Mean Preparation Index of Non-Rigid Group	Mean P.I. Combined
Closed	.479	.453	.466
Open	.397	.411	.404
Combined	.438	.432	.435

Table VI gives the summary table for the analysis of variance of the preparation index on the inductive problems.

Table VI.   Analysis of Variance of the Preparation Index on the Problems Emphasizing Induction.

SOURCE	S.S.	d.f.	M.S.	F ratio	p
Dogmatism	.038449	1	.02844	3.04354	$<$.05
Rigidity	.000360	1	.00036	.0285	...
Dogmatism x Rigidity	.004000	1	.00400	.3167	...
Within	.455000	26	.01263		
Total	.497800	30			

The hypothesis that rigid subjects would not perform as well as the non-rigid subjects on the problems emphasizing deduction and that there would be no differences between the open and closed subjects failed to be confirmed. A comparison of the errors made and of the preparation index for these problems indicates that differences between the rigid and the non-rigid subjects does not approach statistical significance. Furthermore, the differences between the open and the closed subjects, while not statistically significant, is greater than the differences found between the rigid and non-rigid subjects.

The fact that the rigid subjects do not differ from the non-rigid subjects on the problems emphasizing deduction and that there is no significant difference

between the open and closed subjects is evident from an examination of the mean number of errors and mean preparation index for these problems. Table VII below presents the average number of errors made by the subjects in the various groups. It may be seen that the closed subjects make an average of one more error than the corresponding open subjects. The difference between the rigid and non-rigid subjects, however, is considerably less than one.

Table VII. Comparison of the Mean Number of Errors made on Deduction.

	Mean Number of Errors made by the Rigid Groups	Mean Number of Errors made by the Non-Rigid Groups	Mean Number of Errors made by Combined Groups
Closed	6.0	6.2	6.10
Open	5.1	5.0	5.05
Combined	5.55	5.6	5.575

Table VIII below gives the summary table for the analysis of variance of the errors made on the 25 deductive problems.

The probability levels reported for the differences due to Dogmatism are given in terms of a two tailed test of significance as no differences between these groups had been anticipated.

Table VIII.   Analysis of Variance of the Errors made on
              the Problems Emphasizing Deduction.

SOURCE	S.S.	d.f.	M.S.	F ratio	p
Dogmatism	11.025	1	11.025	1.88551	< .25
Rigidity	.025	1	.025	.00427	...
Dogmatism x Rigidity	.225	1	.225	.00625	...
Within	210.500	36	5.84722		
Total	221.775	39			

Table IX below gives the average preparation index
for the problems emphasizing deduction. As indicated by
the analysis of variance of the preparation index for
these problems, the differences between the open and closed
subjects approaches atatistical significance but the differ-
ences between the rigid and the non-rigid subjects does not.

Table IX.   Comparison of the Mean Preparation Index on
            the Problem Emphasizing Deduction.

	Mean P.I. Rigid	Mean P.I. Non-Rigid	Mean P.I. Combined
Open	.350	.337	.3435
Closed	.291	.334	.3125
Combined	.3205	.3355	.328

Table X gives the summary table for the analysis
of variance of the preparation index on the deductive

problems.

Table X.   Analysis of Variance of the Preparation Index
           on the Problems Emphasizing Deduction.

SOURCE	S.S.	d.f.	M.S.	F ratio	p
Dogmatism	.00061	1	.00061	1.99792	< .25
Rigidity	.00225	1	.00225	.46777	...
Dogmatism x Rigidity	.00784	1	.00784	1.62993	...
Within	.17324	36	.00481		
Total	.19304	39			

The fact that the open subjects tend to do better on
all of the problems, and the fact that there is a differ-
ence between the kinds of problems may be seen in a
comparison of all groups on all problems. Table XI below
gives the summary table for the analysis of variance of
the errors made on both the inductive and the deductive
kinds of problems. Table XII gives the summary table
for the analysis of variance of the preparation index for
both sets of problems. It may be seen that Dogmatism
differentiates the groups at a statistically significant
level on the errors made and approaches statistical
significance for the preparation index. There is a
statistically significant difference between the kinds
of problems both in terms of the number of errors made
and the preparation index. The levels of statistical

significance reported are in terms of a two tailed test as no specific prediction had been made concerning the performance of the subjects on all problems or the differences in the difficulty of the problems.

Table XI. Analysis of Variance of the Errors made on Problems Emphasizing Induction and Deduction.

SOURCE	S.S.	d.f.	M.S.	F ratio	p
Dogmatism	46.5125	1	46.5125	4.78	< .05
Rigidity	2.1125	1	2.1125	.22	...
Dogmatism x Rigidity	1.5125	1	1.5125	.16	...
Error (a)	350.5500	36	9.7375		
Problems	99.0125	1	99.0125	22.40	< .01
Dogmatism x Problems	4.5125	1	4.5125	1.02	...
Rigidity x Problems	1.5125	1	1.5125	.34	...
Dogmatism x Rigidity x Problems	.3125	1	.3125	.07	...
Error (b)	159.1500	36	4.4208		
Total	665.1875	39			

Table XII. Analysis of Variance of the Preparation
Index on the Problems Emphasizing Induction
and Deduction.

SOURCE	S.S.	d.f.	M.S.	F ratio	p
Dogmatism	.04224	1	.04224	3.27	$< .10$
Rigidity	.00040	1	.00040	.03	...
Dogmatism x Rigidity	.01153	1	.01153	.85	...
Error (a)	.48685	26	.01352		
Problems	.22898	1	.22898	58.26	$< .01$
Dogmatism x Problems	.00481	1	.00481	1.22	...
Rigidity x Problems	.00221	1	.00221	.56	...
Dogmatism x Rigidity x Problems	.00031	1	.00031	.08	...
Error (b)	.14140	26	.00293		
Total	.91982	79			

Synthesis. The hypothesis that the open subjects
should be superior to the closed subjects and that the
rigid subjects should not differ from the non-rigid
subjects is supported by all three measures of synthesis
on the Denny Doodlebug problem.

Table XIII presents the mean solution times of the
four groups of subjects separately as well as for the
high and low dogmatic subjects and the rigid and non-
rigid subjects is consistent for all three measures as
predicted while the difference between the rigid and non-

rigid subjects is negligible.

Table XIII.   Mean Solution Time for the Denny Doodlebug
               Problem Following the First, Second, and
               All Three Beliefs.

Group	First Belief	Second Belief	All Three Beliefs
High Dogmatism-High Rigid	20.82	15.74	8.64
High Dogmatism-Low Rigid	28.37	23.49	14.45
Low Dogmatism-High Rigid	19.02	12.95	5.60
Low Dogmatism-Low Rigid	11.61	8.40	1.95
High Dogmatism	24.595	19.615	11.595
Low Dogmatism	13.315	10.675	3.820
High Rigid	19.92	14.845	7.165
Low Rigid	19.99	15.945	8.200

Table XIV below gives the summary table for the
analysis of variance of the time required to solve the
problem after the first belief had either been overcome
by the subject or had been given to the subject in the
form of a hint. It may be seen that there is a sig-
nificant difference between the high dogmatic and the low
dogmatic subjects. No such difference exists between
the rigid and the non-rigid subjects. However, there is
a significant interaction between Dogmatism and Rigidity
indicating that the degree to which dogmatism determines
the subject's performance for this measure of synthesis
is influenced by the degree of rigidity for that subject.

Table XIV.   Analysis of Variance of the Time Required to Solve the Denny Doodlebug Problem after the First Belief.

SOURCE	S.S.	d.f.	M.S.	F ratio	p
Dogmatism	861.194	1	861.194	12.60	< .01
Rigidity	.049	1	.049	.01	...
Dogmatism x Rigidity	552.504	1	552.504	8.10	< .01
Within	2460.622	36	68.352		
Total	3881.419	39			

Tables XV and XVI give the summary tables for the analysis of variance of the time required to solve the problem after either the second or the third beliefs had been overcome or given as hints. As was the case with the time required to solve the problem after the first belief was overcome, there is a significant difference between the open and the closed groups while there is no such difference between the rigid and non-rigid groups. Again, there is a significant interaction between dogmatism and rigidity.

Table XV.   Analysis of Variance of the Time Required to Solve the Denny Doodlebug Problem after the Second Belief.

SOURCE	S.S.	d.f.	M.S.	F ratio	p
Dogmatism	799.236	1	799.236	13.77	< .01
Rigidity	25.600	1	25.600	.44	...
Dogmatism x Rigidity	378.225	1	378.225	6.52	< .05
Within	2089.338	36	58.037		
Total	3292.399	39			

Table XVI.   Analysis of Variance of the Time Required
              to Solve the Denny Doodlebug Problem after
              All Three Beliefs.

SOURCE	Sum of Squares	d.f.	Mean Square	F ratio	p
Dogmatism	596.75625	1	596.75625	11.81	<.01
Rigidity	10.71225	1	10.71225	.21	...
Dogmatism x Rigidity	228.00625	1	228.00625	4.51	<.05
Within	1819.68300	36	50.54675		
Total	2655.15775	39			

Analysis. The hypothesis that the rigid subjects
would be slower and discover fewer of the beliefs by
themselves than would the non-rigid subjects while there
would be no differences between the open and closed sub-
jects was generally supported by an analysis of the time
required to discover the different hints.

Table XVII gives a summary of the data concerning
conceptual analysis in terms of the average amount of
time required to overcome one, two, and all three beliefs.
It may be seen that the difference between the open and
the closed subjects is consistent and becomes larger
for the second and third beliefs, but even for the third
belief it is only as large as the difference between the
rigid and the non-rigid groups on the first belief and
fails to be large enough to be statistically significant.
In line with the hypothesized difference between the rigid
and the non-rigid groups it may be seen that it consistently

takes the rigid subjects longer to overcome each of the
beliefs, particularly for the second and third beliefs.

Table XVII.   Comparison of Mean Number of Minutes Taken
              to Overcome the First Belief, and the First
              Two Beliefs, and All Three Beliefs.

Group	First Belief	First Two Beliefs	All Three Beliefs
High Dogmatism-High Rigid	9.72	15.60	22.90
High Dogmatism-Low Rigid	8.51	12.39	21.93
Low Dogmatism-High Rigid	9.88	16.15	23.91
Low Dogmatism-Low Rigid	6.45	9.45	15.90
High Dogmatism	8.115	13.995	22.415
Low Dogmatism	8.165	12.800	19.905
High Rigidity	9.80	15.875	23.405
Low Rigidity	7.48	10.92	18.915

Table XVIII presents the summary table of the analysis
of variance of the time required for either the subject
to discover the first belief for himself or to have it
given to him as a hint.   It is apparent that the differ-
ences between the rigid and the non-rigid subjects fall
short of being statistically significant and that the
differences between the open and closed subjects is
extremely small.   The hypothesis is not confirmed by
this data.

Table XVIII. Analysis of Variance of the Time Required
to Overcome the First Belief.

SOURCE	Sum of Squares	d.f.	Mean Square	F ratio	p
Dogmatism	9.025	1	9.025	.27	...
Rigidity	53.824	1	53.824	1.60	<.25
Dogmatism x Rigidity	12.321	1	12.321	.37	...
Within	1213.186	36	33.6996		
Total	1288.356	39			

A comparison of the time required to overcome two
beliefs gives strong support for the hypothesized difference
between the rigid and non-rigid subjects. Table XIX gives
a summary table for the analysis of variance of the time
required for the subject to discover the first two beliefs
or have them given to him as hints. Clearly the differences
between the rigid and non-rigid groups is statistically
significant while the differences between the open and
the closed subjects remains extremely small.

Table XIX. Analysis of Variance of the Time Required to
Overcome Two Beliefs.

SOURCE	S.S.	d.f.	M.S.	F ratio	p
Dogmatism	14.28025	1	14.28025	.44	...
Rigidity	245.52025	1	245.52025	7.62	<.01
Dogmatism x Rigidity	30.45025	1	30.45025	.94	...
Within	1160.51900	36	32.23663		
Total	1450.76975	39			

When the time required to overcome all three beliefs
is analyzed , the hypothesis is supported at a statistically

significant level, but none-the-less is complicated by
the fact that the differences between the open and
closed subjects is larger than before. Further, for the
first time, there is an interaction between the two
variables which, although not significant, indicates
that the way in which rigidity operates to differentiate
the different subjects' performance on this task may be
influenced by the degree to which the subject is dog-
matic. Table XX below presents the summary table for
the analysis of variance of the time required to over-
come all three beliefs.

Table XX.   Analysis of Variance of the Time Required to
Overcome All Three Beliefs.

SOURCE	S.S.	d.f.	M.S.	F ratio	p
Dogmatism	63.051	1	63.051	1.985	< .25
Rigidity	201.601	1	201.601	6.3476	< .025
Dogmatism x Rigidity	123.904	1	123.904	3.901	< .10
Within	1143.37	36	31.760		
Total	1531.926	39			

A further method of measuring conceptual analysis is
to consider the number of beliefs which were overcome by
the subject on his own before the experimenter gave any
of the beliefs in the form of hints. Table XXI below
gives the chi square analysis of the number of beliefs
overcome by the subject in the first fifteen minutes,

dividing the subjects in terms of their rigidity scores. In order to avoid expected frequencies of less than five in each cell, the number of subjects who overcame two and three beliefs were combined. It is quite evident that the groups differ in their ability to analyze, . this difference being statistically significant beyond the .01 level of confidence and in the direction predicted, that the non-rigid subjects overcame more beliefs than do the rigid subjects. However, when the open and closed subjects are compared in terms of the number of beliefs overcome in the first fifteen minutes of the experiment, as in Table XXII, the differences between the groups are small and insignificant.

Table XXI.   Analysis--The Number of Beliefs Overcome by the Subject in the First Fifteen Minutes of the Experiment.

Group	0 Beliefs	1 Belief	2 Beliefs	3 Beliefs
Rigid	7	11	0	2
Non-rigid	7	1	6	6

Chi Square[1] = 12.608
d.f. = 2
p less than .01

[1]Yates correction for continuity has been applied to all chi square analysis presented.

Table XXII.   Analysis--The Number of Beliefs Overcome
              by the Subject in the First Fifteen
              Minutes of the Experiment.

Group	0 Beliefs	1 Belief	2 Beliefs	3 Beliefs
Open	7	7	4	2
Closed	7	5	2	6

Chi Square = .232
d.f. = 2
p less than .90

Synthesis and Induction. The hypothesis that those
who do well on synthesis should also do well on induction
was not confirmed by the data. Table XXIII below presents
the observed frequencies and the chi square analysis of
the time required to solve the Penny Doodlebug problem
after all three beliefs had been overcome and the number
of errors made on the problems emphasizing induction. In
order to avoid expected frequencies less than five, the
data was analyzed in terms of a two by two table being
divided after 1.99 minutes. It may be seen that while
the differences obtained are not statistically significant,
they are in the direction predicted.

Table XXIII.   Synthesis and Induction--The Time Required
to Solve the DB Problem After All Three
Beliefs Had Been Overcome And The Number
of Errors Made on the Problems Emphasizing
Induction.

		Number of Minutes Required to Solve DB Problem After All Three Beliefs Had Been Overcome.			
		0-1.99	2-3.99	4-5.99	6 and above
Number of Errors made on Inductive Problems	0-3	0	3	2	7
	3-+	3	5	3	5

Chi Square = 3.31
d.f. = 1
p less than .07 one tailed test

Table XXIV below presents the observed frequencies
and the chi square test of the relationship between the
number of minutes required to solve the Benny Doodlebug
problem after all three beliefs had been overcome and
the preparation index for the problems emphasizing
induction. Again the relationship between the two
measures of synthesis is in the direction predicted but
fails to achieve statistical significance. As in the
above Table XXIII, the table was condensed into a two
by two table in order to avoid expected frequencies of
less than five.

Table XXIV.   Synthesis and Induction--The Time Required
              to Solve the DB Problem After All Three
              Beliefs had been Overcome and Subjects
              Scoring Above and Below the Median Preparation
              Index on the Problems Emphasizing Induction.

		Number of Minutes Required to Solve DB Problem After All Three Beliefs Had Been Overcome.			
Inductive Problems		0-1.99	2-3.99	4-5.99	6 and above
Preparation	below .41	8	2	3	5
Index	above .41	4	4	2	0

Chi Square = 1.072
d.f. = 1
p less than .2 one tailed test

While neither of the measures used establish the
connection between induction and synthesis, the fact
remains that in both cases the differences observed
are in the direction predicted. A similar analysis
of the relationship between synthesis and deduction for
which no such relationship is predicted reveals no sig-
nificant differences. Table XXV below presents the chi
square analysis of synthesis with deduction measured in
terms of the number of errors made on the problems em-
phasizing deduction. Similarly, Table XXVI gives the
chi square analysis of synthesis and deduction using the
preparation index of the deductive problems. As in the
chi square tables above, the analysis of the data is made
on a two by two contingency table.

Table XXV. Synthesis and Deduction--Time Required on
the D Problem After All Three Beliefs Had
Been Overcome and Number of Errors Made on
the Problems Emphasizing Deduction.

Number of Minutes Required to Solve D
Problem After All Three Beliefs Had Been
Overcome.

		0-1.99	2-3.99	4-5.99	6 and above
Number of Errors Made on Deductive Problems	0-5	8	4	2	5
	6+	4	4	2	7

Chi Square = .07
d.f. = 1
p less than .50 two tailed test

Table XXVI. Synthesis and Deduction--Time Required on the
D Problem After All Three Beliefs Had Been
Overcome and Subjects Scoring Above and Below
the Median Preparation Index on the Problems
Emphasizing Deduction.

Number of Minutes Required to Solve D
Problem After All Three Beliefs Had Been
Overcome.

		0-1.99	2-3.99	4-5.99	6 and above
Preparation Index	below .225	6	5	2	7
	above .225	6	3	3	3

Chi Square = .119
d.f. = 1
p less than .75 two tailed test

Analysis and Deduction. The hypothesis that subjects who do well on analysis would also do well on deduction was not confirmed by the data. Tables XXVII and XXVIII below give the expected frequencies and the chi square analysis of both the preparation index and the errors made on the deduction problems with the number of beliefs overcome in the first fifteen minutes of the Penny Doodlebug

problem. In both comparisons, those who do well on deduction indicated by either a high preparation index or few errors, also seem to do better on analysis. However, in neither comparison does the relationship between deduction and analysis reach statistical significance. As in the previous chi square analysis, for purposes of statistical evaluation, the table is reduced to a two by two contingency table.

Table XXVII.   Analysis and Deduction--Comparison of Number of Beliefs Overcome in First Fifteen Minutes of DD Problem and the Number of Errors Made on Problems Emphasizing Deduction.

	0 Beliefs	1 Belief	2 Beliefs	All 3 Beliefs
0-5 Errors	4	7	2	6
6 & above	9	6	4	2

Chi Square = 1.28
d.f. = 1
p less than .20 one tailed test

Table XXVIII.   Analysis and Deduction--Comparison of Number of Beliefs Overcome in First Fifteen Minutes on DD Problem and Preparation Index for Problems Emphasizing Deduction.

	0 Beliefs	1 Belief	2 Beliefs	All 3 Beliefs
P.I. below .325	4	8	3	5
P.I. above .325	9	5	3	3

Chi Square = 1.823
d.f. = 1.
p less than .10 one tailed test

By way of comparison to the relationships previously tested in Tables XXVII and XXVIII, Tables XXIX and XXX

present the observed frequencies and the chi square

analysis of analysis with induction. No relationship

is predicted between these variables and it is quite

clear that there is no evidence for the existence of

such a relationship. As was the case when comparing

deduction and analysis, the number of subjects who over-

came either two or three beliefs were combined for the chi

square analysis. As no direction had been predicted, the

two tailed level of significance is reported.

Table XXIX. Analysis and Induction--Comparison of the
Number of Beliefs Overcome in the First
Fifteen Minutes of the DB Problem and the
Number of Errors Made on the Problems
Emphasizing Induction.

	0 Beliefs	1 Belief	2 Beliefs	All 3 Beliefs
0-8 Errors	2	6	0	6
9 & above	6	5	6	2

Chi Square = .339
d.f. = 2
p less than .90

Table XXX. Analysis and Induction--Comparison of the
Number of Beliefs Overcome in the First
Fifteen Minutes of the DB Problem and the
Preparation Index on the Problems Emphasizing
Induction.

	0 Beliefs	1 Belief	2 Beliefs	All 3 Beliefs
P.I. below .325	5	6	2	6
P.I. above .325	6	6	4	2

Chi Square = 1.609
d.f. = 2
p less than .075

Another way in which the relationships between analysis, synthesis, induction, and deduction may be indicated is by means of the correlation between these variables. Table XXXI below gives the correlations between the preparation index for both inductive and deductive problems, the errors made on both sets of problems, analysis measured in terms of the number of beliefs overcome in the first fifteen minutes of the Denny Doodlebug Problem, and synthesis measured in terms of the time required to solve the Doodlebug Problem after all three beliefs have been overcome.

Table XXXI. Correlations Between Induction, Deduction, Analysis, and Synthesis.

	P.I. Induction	P.I. Deduction	Errors Induction	Errors Deduction	Analysis	Synthesis
P.I. Induction	1.00	.73*	.03	.14	-.10	.08
P.I. Deduction		1.00	-.07	.09	-.01	.09
Errors Induction			1.00	.43*	-.01	.22
Errors Deduction			.	1.00	-.25	.28*
Analysis					1.00	-.28*
Synthesis						1.00

* significant beyond the .05 level

From the above table, it may be seen that the preparation index measures correlate quite highly although the mean preparation index for inductive problems was found to be higher than the mean deductive preparation index. Secondly, the correlation between the errors indicates that those who make mistakes on one set of problems also tend to make mistakes on the other. The correlation between analysis and synthesis indicates that doing well on one phase of this task tends to be associated with doing well on the other phase which is most likely due to the correlation between dogmatism and rigidity reported earlier. It should be noted that both of the error measures tend to correlate with synthesis through only deduction does so significantly. Perhaps this reflects general problem ability.

The subjects who participated in this study were
chosen specifically on the basis of dogmatism and only
secondly were they further divided into high and low
rigidity groups. Due to the high correlation between
these two variables, it is not at all surprising to
find that when high dogmatic subjects on the average
score 17 points higher on the rigidity scale than do
the low dogmatic subjects. It would be advantageous in
an extension or replication of this study to equate the
groups beforehand so that there would be no difference
between the high and low dogmatic subjects in terms of
their average rigidity score. Another alternative would
be to test a random sample of the entire range of both
the dogmatism and rigidity scales which would increase
the extent to which the findings of any study such as
this may be generalized. A second difficulty in the
present study concerns the difference in the difficulty
of the problems emphasizing induction and deduction.
The assumption is made that difficulty on these different
kinds of problems lies primarily in either the preparation
or the solution phase. It could be that the differences
found between the high and low dogmatic subjects on the
inductive problems is due to some general problem solving
ability. However, this does not seem reasonable in view
of the fact that significant differences were not found

between these groups on the deductive problems.

In spite of the above limitations, the findings
of this study generally support the assumption that
it is possible to devise tests which separately measure
the ability to integrate beliefs or to analyze the
parts of a problem. The results of this study support
the first hypothesis that open subjects solve inductive
problems better than do closed subjects. This is indicated
both in a comparison of the number of errors made and
of the preparation index for these problems. Open
subjects made fewer errors, and had an average prep-
aration index for these problems. Open subjects made
fewer errors, and had an average preparation index
lower than the closed subjects indicating that they
spent less time on the preparation phase of the problems.
However, the predicted differences between the rigid and
non-rigid subjects was not found on the problems emphasizing
deduction.

The measures of analysis a d synthesis used for the
Denny Doodlebug problem give stronger support for the
differentiation between dogmatism and rigidity. All three
measures of synthesis indicate a difference between the
open and the closed subjects with no such difference bet-
ween the rigid and non-rigid subjects. However, the inter-
action between dogmatism and rigidity is also significant
for all three measures. While the comparison between
rigid and non-rigid subjects regardless of the dogmatism

score is not significant, within either the high or the

low dogmatic group there is a difference between the high

and low rigid subjects. Particularly with the measures

of synthesis which include the time required to solve

the second and third beliefs, the measure of synthesis

includes some measure of the ability to analyze; thus

the interaction between these two variables. The four

measures of analysis presented generally support the

hypothesis that rigid subjects will not be as capable of

distinguishing the parts of the problem or the separate

beliefs to be overcome as will the non-rigid subjects.

Considering the time required to overcome one, two, and

all three beliefs, it is clear that in each case the

difference is in the predicted direction although not

statistically significant for the first belief. The chi

square analysis of the number of beliefs overcome in the

first fifteen minutes of the problem indicates a differ-

ence between the rigid and non-rigid subjects while no

such difference between the open and closed subjects.

The results of the analysis of the relationship between

synthesis and induction were not significant. However, the

trend observed was in the direction predicted, that is those

who excel on synthesis tend to do well on induction.

Similarly, the results of the analysis of the relationship

between analysis and deduction were not significant but were

again in the direction predicted. An analysis of the relation-

ship between either synthesis and deduction, or of analysis

and induction for which no trend had been predicted
indicated no statistically significant relationship be-
tween these variables. It may be that if the relationship
between induction and synthesis could be tested on a larger
sample using the entire range of abilities found in a ran-
dom sample of the population that the trends apparent in
this study would be brought to light.

The compatibility of the findings on the Benny
Doodlebug Problem reported for this experiment with
earlier work done using the same problem is of interest
as this gives an indication of what changes and simi-
larities may be found with specific changes in the
administration of the problem. Table XXXII below gives
the findings from a similar study reported by Rokeach
contrasting dogmatic thinking with rigid thinking
(Rokeach, 1960, p. 188).

Table XXXII.   Ability to Analyze: Comparison Between
               Rigid and Non-rigid Groups and Between
               Closed and Open Groups on Mean Number
               of Minutes Taken to Overcome the First
               Belief, the First Two Beliefs, and All
               Three Beliefs.

Group	First Belief	First Two Beliefs	All Three Beliefs
Rigid	8.6	15.9	19.8
Non-rigid	5.9	14.4	19.4
Closed	7.4	14.9	19.2
Open	7.0	15.3	19.0

It is seen that the closed and open groups do not differ
from each other in analytic thinking while the rigid group
usually takes longer to analyze than the non-rigid group.
The conclusions are similar to those reported from Table
XXXIV, and the times are reasonably similar. Certain
differences appear when comparing the results of these
two studies on their measures of the ability to synthesize.
Table below gives the results from Rokeach's study.

Table XXXIV. Ability to Synthesize: Time taken to Solve
the Doodlebug Problem after the First,
Second, and Third Beliefs Were Overcome
By Rigid and Nonrigid Groups and by Closed
and Open Groups.

Group	After First Belief	After Second Belief	After Third Belief Overcome
Rigid	14.5	7.2	3.2
Nonrigid	15.1	6.6	2.8
Closed	15.2	7.7	3.4
Open	14.4	6.1	2.4

While the general conclusions that the Rigid do not differ
from the Nonrigid and that the Closed take longer to solve
the problem than do Open subjects, the mean solution times
are considerably shorter than those reported from the
present study. However, it should be noted that whether
or not a solution is reached in the study reported by
Rokeach, the session was terminated 30 minutes after the
problem was given to the subject while in the present

study, the subject was permitted 45 minutes to solve
the problem. In another study done by Rokeach and
Vidulich (as reported in Rokeach 1960), in which the
subjects were given 40 minutes to solve the problem,
more compatible times are reported for synthesis in
Table XXXV below while lower mean times for analysis
(Table XXXVI) are reported. This second difference
would appear to be due to another difference in adminis-
tering the problem as the hints were given at the end of
10, 15, and 20 minutes.

Table XXXV. Synthesis: Mean Time Taken to Solve the
             Doodlebug Problem After the First, Second,
             and Third Beliefs Had Been Overcome.

Group	After First Belief	After Second Belief	After Third Belief
Closed-memory	21.9	16.0	11.3
Open-memory	14.2	9.0	4.2

Table XXXVI. Analysis: Mean Time Taken to Overcome the
              First Belief, the First Two Beliefs, and
              All Three Beliefs

Group	First Belief	First Two Beliefs	All Three Beliefs
Closed-memory	3.8	9.7	14.3
Open-memory	3.9	9.1	14.0

The general conclusion which comes from such compar-
isons is that the differences between dogmatic and rigid

thinking are consistent, but the specific differences
found reflect differences in the testing situation.

SUMMARY

To test the relationship between synthesis and analysis
and induction and deduction with dogmatism and rigidity,
Rokeach's Dogmatism Scale and the Gough-Sanford Rigidity
Scale was administered to 341 undergraduates at Michigan
State University. The 20 students scoring highest and
the 20 students scoring lowest on the Dogmatism Scale
were selected for individual testing. Both groups of
subjects were further divided into two groups of ten each
on the basis of their scores on the Rigidity Scale.

The first task consisted of a set of twenty five
analogies emphasizing induction, and another set of
analogies emphasizing deduction. The subject's per-
formance on this task was measured in terms of the
relative amount of time spent on the preparation period
of the problem and on the solution phase of the problem
as well as the number of errors made. The second problem
was the Denny Doodlebug Problem with separate measures of
analysis in terms of the time required to overcome the
beliefs of the problem and the number of beliefs the
subject could overcome by himself, and synthesis measured
in terms of the number of minutes required to solve the
problem after each of the beliefs were overcome.

The hypotheses tested were:

I.   The open group should solve inductive problems
     faster and with fewer errors than the closed
     group. The rigid group should not differ from
     the non-rigid group on this variable.
     This was supported by the data.

II. The non-rigid group should solve deductive
     problems faster and with fewer errors than the
     rigid group. The open group should not differ
     from the closed group on this variable. There
     was an insignificant trend in the opposite
     direction.

III. The open group should solve the synthesis part
     of the Denny Doodlebug problem faster than the
     closed group. There should be no difference
     between the rigid and the non-rigid groups on
     this variable.
     This was supported by the data but there was
     also a significant interaction between dog-
     matism and rigidity.

IV. The non-rigid subjects should overcome more
     beliefs without outside assistance and faster
     than the rigid group. There should be no
     difference between the open and the closed
     groups.
     In general, this was supported by the data.

V.   There should be a relationship between the
     ability to solve deductive problems well and
     the ability to do well on analysis.
     A non-significant trend in the direction
     predicted appeared.

VI. There should be a relationship between in-
     duction and synthesis such that those who
     do well on one task should do well on the
     other.
     A non-significant trend in the predicted
     direction was observed.

The general conclusions of this study are that: (1)

in a problem solving situation in which the primary task

of the subject is to integrate various beliefs of component

parts of the problem open subjects are superior to closed

subjects; (2) in a problem solving situation in which the

task of the subject is to analyze or discover the parts

of the problem, non-rigid subjects are superior to rigid

subjects; (3) there is a tendency for subjects who excel

in synthesis to also excel on inductive reasoning; (4)

there is a tendency for subjects who excel in analysis

to do well on problems emphasizing deduction.

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APPENDIX

Analogies Emphasizing Induction

1. ink	cuttlefish	sting	bee
2. visit	invade	friend	enemy
3. sturgeon	caviar	hen	egg
4. ascend	decend	up	down
5. pregnant	meaningless	full	empty
6. inauguration	completion	infant	adult
7. retina	cochlea	eye	ear
8. demise	cadaver	birth	baby
9. statue	sculptor	book	author
10. oxygen	tank	milk	bottle
11. focus	periphery	center	circle
12. total	section	book	chapter
13. progeny	ancestry	forward	backward
14. numismatics	hobby	waltz	dance
15. naive	sophisticated	simple	complex
16. flask	stopper	bottle	cork
17. noxious	injurious	large	big
18. tabby	spaniel	cat	dog
19. senility	adulthood	evening	day
20. surplus	sufficiency	more	enough
21. jury	convince	target	aim
22. automatic	machine	sour	acid
23. regard	eager	danger	afraid
24. criminal	prison	bird	cage
25. anecdote	relate	meat	carve

Analogies Emphasizing Deduction

1. single	double	monocular	binocular
2. door	key	safe	combination
3. lose	win	liability	asset
4. come	go	inject	eject
5. book	readers	drama	audience
6. ice	skater	tightrope	acrobat
7. buy	sell	acquire	dispose
8. end	beginning	omega	alpha
9. yard	foot	sword	dagger
10. write	letter	seal	envelope
11. round	square	circular	cubical
12. in	out	creditor	debtor
13. one	two	solo	duet
14. leg	arm	knee	elbow
15. shoe	foot	socket	bulb
16. meat	sugar	protein	carbohydrate
17. horse	cat	herbivorous	carnivorous
18. bottle	milk	vein	blood
19. big	small	perennial	annual
20. most	least	increase	decrease
21. knife	fork	groom	bride
22. sky	ground	heavenly	earth'y
23. near	far	entry	exit
24. thin	thick	diverge	converge
25. succeed	fail	solvent	bankrupt

PSYCHOLOGY QUESTIONNAIRE

The following is a study of what the general public thinks and feels about a number of important social and personal questions. The best answer to each statement below is your personal opinion. We have tried to cover many different and opposing points of view; you may find yourself agreeing strongly with some of the statements, disagreeing just as strongly with others, and perhaps uncertain about others; whether you agree or disagree with any statement, you can be sure that many other people feel the same as you do.

On the IBM answer sheet which you have been given, mark each statement in the space provided according to how much you agree or disagree with it. Please mark every one. Blacken spaces +3, +2, +1, -1, -2, or -3 depending on how you feel in each case, using the following numbers:

+3 I agree very much.	-3 I disagree very much.
+2 I agree on the whole.	-2 I disagree on the whole.
+1 I agree a little.	-1 I disagree a little.

Are there any questions? Please make no marks on this booklet.

1. A person who thinks primarily of his own happiness is beneath contempt.

2. I am often the last one to give up trying to do a thing.

3. The main thing in life is for a person to want to do something important.

4. Everyone at times thinks about things too bad to talk about.

5. In a discussion I often find it necessary to repeat myself several times to make sure I am being understood.

6. There is usually only one best way to solve most problems.

7. Most people just don't know what's good for them.

8. It is not always easy to tell the truth.

9. In times like these, a person must be pretty selfish if he considers primarily his own happiness.

10. I prefer work that requires a great deal of attention to detail.

11. A man who does not believe in some great cause has not really lived.

12. Most people get angry sometimes.

13. I'd like it if I could find someone who would tell me how to solve my personal problems.

14. I often become so wrapped up in something I am doing that I find it difficult to turn my attention to other matters.

15. Of all the different philosophies which exist in this world there is probably only one which is correct.

16. I dislike to change my plans in the midst of an undertaking.

17. It is only when a person devotes himself to an ideal or cause that life becomes meaningful.

18. If I could get into a movie without paying and be sure I was not seen I would probably do it.

19. In this complicated world of ours the only way we can know what is going on is to rely on leaders or experts who can be trusted.

20. I never miss going to church.

21. There are a number of persons I have come to hate because of the things they stand for.

22. I like to know some important people because it makes me feel important.

23. There is so much to be done and so little time to do it in.

24. I usually maintain my own opinions even though many other people may have a different point of view.

25. It is better to be a dead hero than a live coward.

26. I do not like everyone I know.

27. A group which tolerates too much differences of opinion among its own members cannot exist for long.

28. I find it easy to stick to a certain schedule, once I have started it.

29. It is only natural that a person should have a much better acquaintance with ideas he believes in than with ideas he opposes.

30. I gossip a little at times.

31. While I don't like to admit this even to myself, my secret ambition is to become a great man, like Einstein, or Beethoven, or Shakespeare.

32. I do not enjoy having to adapt myself to new and unusual situations.

33. Even though freedom of speech for all groups is a worthwhile goal, it is unfortunately necessary to restrict the freedom of certain political groups.

34. Some people vote for men about whom they know very little.

35. If a man is to accomplish his mission in life it is sometimes necessary to gamble "all or nothing at all."

36. I prefer to stop and think before I act even on trifling matters.

37. Most people just don't give a "damn" for others.

38. Once in a while I laugh at a dirty joke.

39. A person who gets enthusiastic about too many causes is likely to be a pretty "wishy-washy" sort of a person.

40. I try to follow a program of life based on duty.

41. To compromise with our political opponents is dangerous because it usually leads to the betrayal of our own side.

42. At times I feel like swearing.

43. If given the chance I would do something of great benefit to the world.

44. I usually find that my own way of attacking a problem is best, even though it doesn't always seem to work in the beginning.

45. In times like these it is often necessary to be more on guard against ideas put out by people or groups in one's own camp than by those in the opposing camp.

46. I do not read every editorial in the news-paper every day.

47. In a heated discussion I generally become so absorbed in what I am going to say that I forget to listen to what the others are saying.

48. I am a methodical person in whatever I do.

49. Once I get wound up in a heated discussion I just can't stop.

50. I think it is usually wise to do things in a conventional way.

51. There are two kinds of people in the world: those who are for truth and those who are against the truth.

52. My table manners are not quite as good at home as when I am out in company.

53. Man on his own is a helpless and miserable creature.

54. The United States and Russia have just about nothing in common.

55. In the history of mankind there have probably been just a handful of really great thinkers.

56. I always finish tasks I start, even if they are not very important.

57. The highest form of government is a democracy and the highest form of democracy is a government run by those who are most intelligent.

58. I would rather win than lose in a game.

59. The present is all too often full of unhappiness. It is only the future that counts.

60. I often find myself thinking of the same tunes or phrases for days at a time.

61. Unfortunately, a good many people with whom I have discussed important social and moral problems don't really understand what's going on.

62. I have a work and study schedule which I follow carefully.

63. Fundamentally, the world we live in is a pretty lonesome place.

64. I find it hard to make talk when I meet new people.

65. It is often desirable to reserve judgment about what's going on until one has had a chance to hear the opinions of those one respects.

66. I usually check more than once to be sure that I have locked a door, put out the light, or something of the sort.

67. The worst crime a person could commit is to attack publicly the people who believe in the same thing he does.

68. I have never done anything dangerous for the thrill of it.

69. In the long run the best way to live is to pick friends and associates whose tastes and beliefs are the same as one's own.

70. I believe that promptness is a very important personality characteristic.

71. Most of the ideas which get printed nowadays aren't worth the paper they are printed on.

72. I am always careful about my manner of dress.

73. It is only natural for a person to be rather fearful of the future.

74. I always put on and take off my clothes in the same order.

75. My blood boils whenever a person stubbornly refuses to admit he's wrong.

76. When it comes to differences of opinion in religion we must be careful not to compromise with those who believe differently from the way we do.

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