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RIGIDITY OF CONCEPT UTILIZATION AS A FUNCTION OF

INDUCTIVE AND DEDUCTIVE DERIVATION

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CHAPTER I

INTRODUCTION

The general problem in this study was to determine whether concepts differed in strength and rigidity according to whether they had been derived inductively (through direct, step-by-step experience with the referent of the concept) or deductively (through instructions, by formula, dictum, etc.). A special attempt was also made to distinguish between concept rigidity and concept strength.

More specifically, concepts already mastered by subjects were studied. Subjects were led to develop a concept with respect to the appropriateness or usefulness of another pre-existing concept, either inductively or deductively and at one of two initial levels of intended strength. The stimulus situation was then progressively altered to make the experimentally-produced concept increasingly inappropriate. The course or pattern of change in concept utilization was followed longitudinally in an attempt to separate a factor of concept rigidity from concept strength and to relate rigidity of concept utilization to the history of the formation of the concept.

It was expected that the deductive procedure would result in initially stronger concepts than would the inductive procedure, under the conditions of this experiment. It was also expected that concepts derived deductively would be utilized in a more rigid manner than those derived inductively. Finally, it was expected that discredited deductively-derived concepts would be more difficult to reinstate than discredited inductively-derived concepts.

Induction is used in this study in approximately the customary sense--as a label for learning through step-by-step, personal experience with the referent of the concept. Generalization from varied experience is implied, whether the subject is consciously aware of the generalization or not.

However, deduction is used in what may be considered a somewhat unusual sense--as a label for learning through instructions, by dictum or formula, etc., and some justification of this usage may be desirable. Sherif and Sherif (1956) have written:

> Through the medium of language human beings can and do learn about the social and physical world they live in without always having direct, first-hand experience with all of its aspects. This possibility of a short cut in the laborious process of learning entirely through direct action and experience with every object and event has direct bearing on the socialization process (Sherif & Sherif, 1956, pp. 450-451).
>
> Many of our values or norms are internalized through the formation of attitudes by new members on the basis of formula, short-cut verbal dicta, or example

> before they have had sufficient or (in some cases) any actual encounter with the referents of these attitudes. That is, many social attitudes are formed deductively through formula rather than through step-by-step personal experience sith the objects encompassed in the value verdict of the norm (Sherif & Sherif, 1956, p. 496).

Another discussion of concept formation under various conditions is that of Leeper(1951). He deals explicitly with concept formation under three headings--inductive, deductive, and inventive--suggesting that inventive concept formation may be just a special case of inductive concept formation. He says of inductive concept formation:

> What do we mean by inductive concept formation? Partly we mean a process that is defined by what it produces--namely, concepts. It is the process of developing a habit or cognitive mechanism that permits a person to respond to an object or event in terms of some property of which he may or may not be immediately aware. By inductive concept formation we also mean the <u>process</u> by which concepts are formed. Inductively formed concepts originate in the experiences and observations that provide the organism with a wealth of perceptual materials. The process of inductive concept formation, then, is the experiencing of one thing after another and the selective perception of certain aspects of the materials as common to several objects (Leeper, 1951, pp. 740-741).

With respect to deductive concept formation he says:

> Deductive thinking, or deductive concept formation, is a very common process. We often fail to appreciate this fact because we conceive of deductive thinking solely in terms of the fully stated syllogism. Actually it occurs most often in everyday life as the enthymeme. . . . The major premise is assumed, rather than stated. But psychologically it is playing its role as truly as though it were stated (Leeper, 1951, p. 748).

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From this view of deduction, then, it follows that the consequences of instructions in any psychological experiment rest on deductive processes in the subject--usually of an enthymeme nature. For example, if the experimenter informs subjects, as in this study "All of the following words have to do with food and eating," and if a subject reveals by his subsequent responses that he does, indeed, expect food-related words, something like the following must have intervened:

1. This person tells me the following will be food-related words.
2. He is a teacher (psychologist, parent, etc.).
3. Generally, what I am told by teachers (etc.) is true.
4. Therefore, all the following words must be food-related.

The intervening process is, of course, unlikely to have been so formal or conscious in nature as the example might appear to indicate. However, to see that the consequence would be different if different premises intervened in the implicit deductive process, substitute "idiot," or "communist" in step 2, or substitute "false" for "true" in step 3. We know that effective instructions in any experiment must come from some at least superficially credible source or the instructions may result in contra-instruction expectations.

Other authors have also made very similar distinctions between inductive and deductive modes of concept formation, set or expectancy production, etc. (though in different words). Among these are Allport (1955, p. 218), Bruner (1957, pp. 44-45), Festinger (1957, p. 130), Postman (1951, p. 263), and Vinacke (1952, p. 86).

Experiments Utilizing Inductively- and Deductively-Derived Concepts

It has long been recognized that concepts are some sort of learned cognitive products and that they may be learned in various ways. Sometimes concepts are learned in an inductive way--through sequential experiences with the referent or object of the concept. However, sometimes concepts are learned deductively--by formula or verbal dictum, without direct contact with the referent of the concept. Although there are many indications in the experimental literature that history of concept formation may be a crucial determinant of concept strength and rigidity, the specific effects are far from clear.

For example, early experiments on concepts underlying racial prejudice (*e.g.*, Horowitz, 1936; Lasker, 1929) demonstrated that such concepts are less often built up inductively by contact with members of the out-group than deductively by learning the established conceptions of the in-group. This particular example of deductively-derived concepts is generally considered an area of strong, rigid concepts (stereotypes), but it is still not known whether this is a simple consequence of the ego-involvement of the individual with his group or, in part, a consequence of deductive derivation of the concepts.

Other experiments such as those performed by Luchins (1942) have shown that strong concepts can also be built up inductively and that rigidity of utilization is frequently associated with these. However, in Leeper's (1935) summary of a considerable experimental literature on inductive concept formation and a smaller literature on deductive concept formation, he reports no research in which the relative consequences of having derived the same or similar concepts inductively and deductively are compared--the object of the present study.

The experimental literature includes a large number of studies in which subjects have been led to derive concepts inductively or deductively. A few studies have used both procedures in the same experiment, though for different purposes than in the present study. Many examples of the induction procedure are found in summaries by Gibson(1953), by Luchins (1942; 1957), and in the extensive series reported by Bruner, Goodnow, and Austin (1956). Experiments which have produced concepts through instructions provide, also, an extremely large number of examples of deductively-produced concepts, though for the most part they are unintentional examples. Some few experiments have used and evaluated deductive procedures as a focal aspect of the study.

The present study, in part, produces expections (concepts) that items to be presented will be members of a particular category, through subject experiences with members of the category (*i*.*e*., inductively), a technique long in use in concept (*e*.*g*., Hull, 1920) and set (*e*.*g*., Rees & Israel, 1935) investigations. More recent studies employing concept-induction procedures are those of Maltzman and Morrisett (1952; 1953a; 1953b) and Postman and Crutchfield (1952). Studies by Blake and Vanderplas (1950-51) and Bruner and Postman (1949) also violate or discredit experimentally-induced concepts--a procedure utilized in the present experiment. These studies constitute, of course, only a small sample of early and recent research exploring various hypotheses and producing concepts inductively.

The present study also aims at production of expectations (concepts) deductively, and there are also early and later examples of this procedure in the experimental literature. Following Kulpe's early work on *Aufgabe*, Chapman (1932), among others, demonstrated the increased accuracy of reporting stimulus aspects to which attention had been called by instructions (deductive procedure, from the subject's point of view). Siipola (1935) and Zangwill (1938) used instructions to produce an increased predictability of perception of ambiguous stimuli, and Leeper (1935) used "picture instructions" in his study of the pirate-rabbit, ambiguous drawing to produce a set for one or the other alternative.

In a variation on the experimental design used by Siipola (1935), Vinacke (1952, pp. 311-313) produced expections of category words deductively (through instructions). Tachistoscopically-presented ambiguous stimuli were more frequently reported in the category that subjects had been instructed to expect than in other or neutral categories. Immediately following this part of the experiment, sets of "skeleton" words were distributed to the same subjects--ambiguous stimuli subject to completion in line with either an experimental category or in a noncategory way. Subjects again reported more items in categories they had been instructed to expect, although the second part of the experiment was presented to them as a separate unit--a speed test. The deductively-produced concepts, then, generalized to a similar task where it could not be said that subjects were simply following instructions for the task at hand. These examples of deductive concept formation, again, constitute only a small sample.

Some few studies have employed both inductively-achieved and deductively-achieved concepts in the same experimental design (as in the present study), but for different purposes. For example, Walter (1955) allowed expectations of extent of autokinetic movement to arise inductively and then produced altered perceptions by means of deductive procedures--not once, but three times for each subject. Inductive and deductive procedures were employed sequentially and it was shown that concepts can be broken down, as well as formed, deductively.

Henle (1942) presented printwise and reverse order words tachistoscopically and found that subjects recognized the reversed words with greater difficulty. However, when expectation of some reversed words was produced deductively (by instructions), the recognition advantage of the customary order was reduced. Hill (1953) studied perceptual judgments in an experiment employing both deductive and inductive concept formation procedures. Judgments of symmetry of specially-constructed figures were elicited. Half the subjects were "set" by instructions (deductively) for "above average symmetry," and half were uninstructed. Within each of these experimental groups half the subjects were provided a standard of "average symmetry," i.e., direct experience with the referent of the concept. It was expected that the deductively-produced concept would become ineffectual or would be reduced in influence when stimulus ambiguity was reduced by the inductive experience. Although the hypothesis received only marginal support, the influence of the deductively-produced concept was highly significant.

These studies by Henle (1942), Hill (1953), and Walter (1955) demonstrate the interaction of inductive and deductive processes in concept formation and change. They also provide evidence suggestive of the greater relative potency or efficacy of deductive procedures as compared with inductive procedures.

Maltzman and Morrisett (1953b) incorporated a training procedure (inductive) and set instructions (deductive) in the same design, producing expectations that anagram solutions would fall into "nature" and "order" solution categories. All subjects solved twenty anagram problems in one category or the other, and half of each group were also instructed that it would help to look for category words--by category name. No subjects were given a concept deductively in the absence of inductive evidence for the same concept. Effectiveness of the concepts thus produced was tested with a set of fifteen ambiguous anagrams capable of solution either in line with concept or not.

Both inductive and deductive concepts produced significant effects in the expected direction in the test series. Also, those given both inductive and deductive evidence produced significantly more category responses on the test series than those given inductive training only. However, since no subjects received deductive evidence only prior to the ambiguous test series, no comparison of the relative efficacy of the two procedures was possible.

In a study by Postman and Leytham (1951), personality trait names were presented tachistoscopically to two groups of subjects. After three practice words, one group was allowed to develop a set for the category words by responding to an unbroken series of twelve such words (inductive procedure). The other group was told to expect trait names after the three practice words, and then they responded to the same sequence of category words (deductive concept formation, followed by inductive confirmation). No subjects experienced a deductive procedure without unequivocal inductive confirmation _before_ testing. An expectation for category words was developed in both groups (lowered recognition thresholds), and it developed more rapidly for the instructed subjects.

An additional feature of particular interest in the Postman and Leytham (1951) study was a test for differential persistence of set in the two groups at the end of the series of category words. Two noncategory words were presented, violating subject expectations. Recognition thresholds were significantly elevated for the first of these noncategory stimuli, constituting a measure of the strength of the expectation for category items. Presentation of the second noncategory stimulus resulted in a significant decrease in recognition threshold. These results were seen in each experimental subgroup, but differences between groups were not significant. The authors report:

> In neither case, however, is the difference between differences significant. . . . The relative amount of rise and fall in thresholds, then, is not significantly different for the two groups.
>
> These results clearly illustrate the effect of selective set on perceptual discrimination, _regardless of whether the set is induced by explicit instructions or is built up through experiences_ (Postman & Leytham, 1951, pp. 402-403). (Italics mine)

It should be noted that with only two noncategory items at the end of the concept production series it would be difficult to recognize any differential effects of concept formation procedures on the course or pattern of change.

In the studies by Maltzman and Morriset (1953b) and Postman and Leytham (1951) the experimental design was similar, up to the additional test described above in connection with the latter study. Expectations for items of a category were induced in all subjects through their own direct experience with items of the category. Half the subjects in each experiment were also instructed, prior to the inductive experience, to expect category items. Tests of the expectations thus generated revealed stronger expectations by preinstructed subjects in both studies. Postman and Leytham (1951) made an additional test of concept strength by violating the subjects' expectations, and found no differences to be associated with method of concept formation.

The studies summarized above offer considerable evidence on the strength of expectations generated deductively, but no evidence on whether concepts differ in rigidity (as seen in the pattern of change) according to whether they were derived inductively or deductively.

Strength and Rigidity of Concepts and Ego-Involvement

The very large experimental and theoretical literature on attitude change and change of set provides many examples of a continuing interest in topics of concept strength and rigidity, *e.g.*, Sherif and Sherif (1956, Ch. 16) and summaries by Luchins

(1942; 1947; 1957), and Hovland, Janis, and Kelly (1953). The studies described in these sources have examined the influence of a large number of independent variables on change of concepts and have employed, as well, a large number of dependent variables in measuring content, direction, and position, or intensity, strength, and rigidity. For the most part, conclusions have been based on comparisons of (usually two) point-in-time measures, although some studies have attempted to follow the course of change in a systematic way. Studies have also varied greatly in the extent to which they have attempted to utilize controlled "laboratory" conditions or to approximate realistic "field" conditions.

In a number of the studies mentioned in the preceding section, concept strength was utilized in making predictions about change or was inferred from change (or resistance to change), _e.g._, Henle (1942), Hill (1953), Maltzman and Morrisett (1952; 1953a; 1953b), and Postman and Crutchfield (1952). Kelly (1957) has documented the typicality of such experimental procedures. Among the many studies reporting that concept strength accounts for resistance to change are those of Buss (1950), Dittes and Kelley (1956), Harvey, Kelley, and Shapiro (1957), and Kelley and Volkart (1952).

However, not all researchers agree that resistance to change is a function of concept strength. Some studies have emphasized external, rather than internal, factors, _viz_., amount or degree of change proposed or attempted. Examples are the studies of Ewing (1942), Goldberg (1954), and Hovland and Pritzker (1957). Harvey, Kelley and Shapiro (1957) combined the two propositions in their report that initial attitude strength was negatively related to change but that for both strong and weak attitudes greater change was associated with larger proposed changes.

The studies of concept change just mentioned made no distinction between concept strength and concept rigidity. It was assumed where there was any interest in rigidity, that a strong concept was a rigid one, *i.e.*, resistant to change. The theoretical views of Allport (1955), Osgood and Tannenbaum (1955), and Postman (1951) also deal with strength or intensity of concepts as a unitary factor.

Other researchers have been specifically concerned with behavioral rigidity, and controversy in this area has revolved largely around the issue of generality or specificity of the rigid behavior--that is, whether behavioral rigidity is situational *or* determined by personality factors of the individual. Associated with the personality point of view have been Aderno, *et al*. (1950), Frenkel-Brunswik (1949), and Rokeach (1948), among others. Luchins (1947) and Bruner, Goodnow, and Austin (1956) have reported intrapersonal consistencies which were not referred to personality rigidity. Resistance to the "personality viewpoint" has come from Luchins (1949; 1951; 1957) and Goodstein (1953), among others. Factor analytic studies (*e.g.*, Cattell & Tiner, 1949; Cattell & Winder, 1952; Kleemeier & Dudek, 1950) yielded largely negative or equivocal results in attempts to isolate "pure" rigidity and flexibility factors.

Among the many studies which document the importance of situational factors as determinants of behavioral rigidity are those of Blake and Vanderplas (1950-51), Eckstrand and Wickens (1954), Wyatt and Campbell (1951), and Youtz (1948). Although the specificity-generality issue is not focal for present purposes, a number of relevant experiments have been motivated by the controversy, *cf.*, review by Taylor and McNemar (1955).

The question has not been subject to any simple or easy solution in the either-or form in which it has so often been posed, and a great many research findings and theoretical considerations argue for changing the form of the specificity-generality question to "under what conditions." It has long been recognized that the behavior of individuals becomes more consistent when the individual becomes more ego-involved. Operationallv, of course, the differentiation between "consistency" and "rigidity" depends on whether the perseveration of response is seen as meeting the demands of the situation or not (*cf.*, Woodworth & Schlossberg, 1954, p. 830).

Summaries of relevant research findings are found in Sherif and Sherif (1956, pp. 580-591), and additional experimental findings also lend support to the view that the conditions under which response perseveration tends to generalize to increasingly dissimilar stimulus situations are conditions of ego-involvement, *e.g.*, Brown (1953), Cowen and Thompson (1951), and Pitcher and Stacey (1954).

Consistency (or rigidity) of behavior varies, then, with degree of ego-involvement, and under extremely high degrees of ego-involvement experience and behavior become extremely rigid. Such influences from prejudice and stereotypes are well known, and a recent report by Festinger, Riecken, and Schacter (1958) provides another striking example.

In view of these considerations, the present study was purposely designed to produce only a low level, if any, ego-involvement. Also, an attempt was made to control for this factor by attributing all information supplied to subjects to a single source--the experimenter. However, it is not contended that ego-involvement was necessarily fully controlled thereby.

Dependent Variables in Studies of Concept Strength and Rigidity

Since it was a primary objective of the present experiment to demonstrate a difference between concept strength and concept rigidity, the choice of dependent variables became crucial. In the studies reviewed above, those in which concept strength was intentionally varied or intentionally measured have failed to distinguish between strength and rigidity. Rigidity was viewed simply as consequence of strength. The results of those which explored problems of behavioral rigidity are understandable in terms of differential ego-involvement or concept strength. It is proposed in the present study that a factor of concept rigidity is separable from concept strength, and that one of the variables (probably only one of many) which influences concept rigidity (or rigidity of utilization of concepts) is the history of formation of the concept--particularly, whether it was derived inductively or deductively.

One reason for the failure to recognize that not one factor, but two, are involved has been an emphasis on measures of net change--comparison of (usually two) point-in-time measures--which has tended to obscure any difference in the course of change of concepts. Recognition of the importance of longitudinal studies is not, of course, new. Some early (e.g., Piaget, 1932), and more recent research (e.g., Bruner, Goodnow, & Austin, 1956; Inhelder & Piaget, 1958; Sherif & Sherif, 1956, Ch. 6 and 9) has systematically followed the course of concept change over time. However, none has explored the problem of the present study, and it remains true that the bulk of research in attitude-change and change-of-set areas has utilized measures of net change as derived from (usually two) points-in-time measures (cf., Kelley, 1957, p. 230; Luchins, 1957, p. 97).

With the dependent variable handled in this way, an important possibility may be overlooked. It may be that two individuals holding the same concept with apparently the same initial strength or intensity may change their concepts in the same net amount during an experiment, but do so in very different ways. If one person responds realistically to changing stimulus conditions--adjusting his conceptions accordingly--and the other resists change until the last moment--changing rapidly when he does--both will be represented by the same numerical value in the net change data.

There are grounds in both the experimental literature (e.g., Sherif & Sherif, 1956, pp. 553-554) and in everyday observations to suggest a definition of concept rigidity in terms of an initial resistance to change, followed by large or rapid change--when change does occur. We notice, for instance, that people in arguments sometimes seem to hold the same attitude with equal intensity, but one will adjust and adapt his notions as the discussion reveals new facts, while the other resists loudly, evades the issue if possible, but also changes his notions (and suddenly) when the evidence against his position becomes overwhelming. In terms of initial and terminal measures, the strength of the two individuals' concepts would appear to be the same. We have noticed, however, that the pattern of change differed radically in the two instances and that the instance of initial resistance followed by sudden change fits some connotations of the term "rigidity," viz., apparent strength, but actual brittleness, vulnerability, fragility.

Some experiments have come close to the distinction proposed here, but none have demonstrated it in clear-cut fashion, and some researchers have even concluded that their data support no distinction between concept strength and concept rigidity. For example, Guetzkow (1951) attempted an experimental separation of "susceptibility to set" (measured as strength of set produced) and "ability to overcome set" (flexibility). Differences between the two measures were not significant, necessitating the conclusion that results were explainable in terms of one factor, not two.

In view of the research summarized above, it would appear that if there are, in fact, two factors (strength and rigidity) inferable from dependent measures in concept-change studies, rather than a single factor (strength, intensity, energy), certain stringent requirements are placed on an experimental design which proposes a separation of the factors. It was necessary to start the test procedure with concepts of equal measured strengths, produce equal change in the concepts, and show that the course or pattern of change differed significantly for the more rigid concepts.

The dependent variables chosen for the present study revealed concept change longitudinally--the process or pattern of change. Utilizing these dependent measures, in the required design, hypotheses were tested with respect to the differential association of concept strength and concept rigidity with inductive and deductive concept derivations, at two levels of initial concept strength.

The hypotheses specified below were tested in an experimental design in which concepts (expectations that stimuli would be members of a specified conceptual category) were produced (experimenter viewpoint) or achieved (subject viewpoint). They were produced at two initial levels--"All" and "Most" expectations--and by two experimental procedures--"Deduction" (instructions) and "Induction" (prior response to category items). Following a test of concept strength, all subjects experienced identical stimulus conditions designed to discredit or invalidate the experimentally-produced concepts, *i.e.*, to produce change. Finally, concepts having been experimentally produced and discredited for all subjects, an attempt was made to reinstate the discredited concepts.

HYPOTHESES

Hypothesis 1. Under the experimental conditions of this study, deductively-derived concepts are stronger than inductively-derived concepts. Tests of the hypothesis are made at both "All" and "Most" levels of initial expectation.

Hypothesis 2. Concepts change--are discredited--under the specified stimulus conditions, regardless of initial strength or method of production.

Hypothesis 3. Deductively-derived concepts are more rigid or inflexible under pressure-to-change than inductively-derived concepts of equal initial strength. That is, concepts achieved deductively exhibit rigidity by resisting change more, early in the course of change, but change more rapidly than do inductively-achieved concepts, late in the course of change.

This hypothesis and the one to follow are tested only in connection with data from subjects who actually arrived at the intended initial levels of concept strength.

Hypothesis 4. Deductively-derived concepts, when discredited, are more difficult to reinstate than inductively-derived concepts.

CHAPTER II

SUBJECTS, STIMULUS CONDITIONS, AND PROCEDURE

Subjects

Subjects for this experiment were undergraduate students at Texas College of Arts and Industries, Kingsville, Texas. A sample of 370 male and female, sophomore and junior subjects was used in the standardization of stimulus conditions. An additional sample of 137 was used in pretesting instructions and in testing adequacy of experimental procedures and controls. The experimental sample was composed of 320 male and female freshman students enrolled in English courses. Experimental data from fourteen subjects who submitted incomplete response records are not included in this number. In the experimental sample 182 subjects (57%) either read or spoke more than one language.

Subjects were distributed over five groups--four experimental groups and one control group. It was expected that more subjects would arrive at stipulated concept strengths under Deduction than under Induction procedures. Therefore, a relatively larger number of subjects was assigned to the Induction procedure (90 in each subgroup as compared with 50 in each Deduction subgroup and 40 in the Control group).

Stimulus Conditions

Tests of the hypotheses in this experiment required a large class of stimuli to each of which could be assigned response probabilities by some reliable standardization procedure. A decision was made to use skeleton words (some letters missing) as the stimulus objects with respect to which a concept was to be produced, discredited, and reinstated. The stimuli had to be chosen from some large word category, responses to which were subject to unambiguous scoring, *i.e.*, clearly assignable to category or non-category classes. The category chosen had to be one which subjects customarily use, so that clear-cut positive expectations might be produced. This meant, of course, that a verbal category was required which relates to some strong and persistent motivational factors for speakers of the language.

A number of such word categories were explored and rejected for these purposes for one reason or another, *e. g.*, category too small or not sufficiently familiar to large numbers of subjects, difficulties in scoring responses, etc. The category finally chosen for use in this experiment was the "food and food-related words" category used by Postman and Crutchfield (1952). It satisfies criteria for size, familiarity, and assurance in scoring responses. It is, of course, known that perceptual tendencies with respect to such stimuli are subject to influence by the degree of hunger of the individual at the time of response. However, this factor can be controlled, and the manner in which this was accomplished is described below.

Choice of food-related words as the conceptual category has the additional advantage of making possible some comparison of response probabilities with similar standardizations in a previous experiment by Postman and Crutchfield (1952). Hereafter, "food and food-related" words will be referred to as "category words; all others, as "noncategory words. The "noncategory" label should not be taken to mean that associations with food cannot occur, but merely that they are considerably more remote than for "category" words. For example, "black" might arouse images of a field of licorice for some particular individual, but this association is considerably less likely than that "fish" or "kitchen" will be thought of as intimately related to food and eating.

In the stimulus standardization procedure, four lists of 120 skeleton words each were constructed and administered to 370 subjects, so as to make available a large number of both category and noncategory items for which would be known the probabilities of category response, noncategory response, ambiguity (difference between these), and difficulty (nonresponse). Each of four stimulus standardization lists contained the same sixty noncategory skeletons combined with one or the other of two sets of sixty category skeletons. Two forms contained the same sixty category skeletons in two random orders. Two other forms contained a different set of sixty category skeletons combined with the same sixty noncategory skeletons, and again in two random orders, so as to make possible an estimate of the extent to which particular skeletons were subject to "order" effects. That is, if a particular stimulus elicited widely different proportions of category and noncategory responses according to its place in a series of such stimuli, its usefulness for this experiment would be questionable.

Standardization data are available on 120 category skeletons--68 from the previous study (Postman & Crutchfield, 1952) and 52 newly constructed--and on 60 noncategory skeletons (all newly constructed). The 370 stimulus standardization subjects were distributed over the four lists of stimulus items in approximately equal numbers. The lists were administered to intact classes meeting at 9:00 and 10:00 A.M. and at 2:00 and 3:00 P.M. so as to control for relevant motivational factors. The following instructions were given orally prior to distribution of stimulus materials:

> I'll ask you to take just a few minutes to help me with an experiment on reading. At the moment, I'm just trying to find out how much of the printed word people really need to see in order to know what the word is, and whether some words are easier to recognize than others.
>
> I will hand you some sheets stapled together, on which there are some "skeleton" words--that is, words with some letters missing. You are asked to insert letters in the blanks so as to make English words of the skeletons. Two letters are needed to complete each word. Avoid slang and proper names. Give the first solution that occurs to you and work rapidly. I am not interested in the correctness of your spelling.
>
> Are there any questions?

Subjects were allowed to use as much as 25 minutes on the task (which proved sufficient), and then the lists were collected.

Responses were scored as "category," "noncategory," "nonword," and "nonresponse" for each of the category stimuli, and these were tabulated. For noncategory stimuli, 370 responses each were available; for the category stimuli, approximately 185 per word, since each of these appeared on only two of the four lists. Consequently, in the standardization procedure, some 44,400 responses were collected. Category skeleton responses were tabulated as described above, and responses to noncategory skeletons were tabulated for difficulty (nonresponse) only, since they had been constructed so that no category response to them was possible.

In the scoring of responses spelling constituted a problem. It proved necessary in a preliminary test preceding formal standardization procedures to deemphasize spelling in instructions to subjects because otherwise subjects completed only those items they were completely certain they could spell correctly. Fortunately, the local misspellings follow a fairly consistent pattern, and the intent of a particular spelling could be elicited by questioning subjects. One stimulus, r_d_sh, had to be discarded because about half the subjects who completed it "redish" meant "radish" and about half meant "reddish." For "dessert," two misspellings were accepted--"dissert" and "dessart"--since subjects consistently classified it as a food word. Other examples of misspellings accepted as category items in scoring both standardization and experimental responses were: "leatuce" for "lettuce," "sousage" for "sausage," "tamato" for "tomato," etc. No stimuli were included in the experimental series on which there were unresolved scoring problems.

In the process of scoring, six category skeletons were discarded when unambiguous scoring proved impossible. These were found in both the newly constructed skeletons and in those used in the previous study (Postman & Crutchfield, 1952). For example, is the response "orange" a fruit or a color; does "grain" refer to cereal or texture, etc? The remaining sample of 114 category stimuli are listed in Appendixes A and B with their associated probabilities (percentages) of category responses, noncategory responses, and nonresponses. Appendix A contains the newly constructed stimuli. Appendix B includes only those stimuli also standardized previously (Postman & Crutchfield, 1952). The separation was provided in order to facilitate reference in the event of employment of these items in subsequent research.

Two possible measures of "difficulty" were available--the nonresponse percentages for each stimulus and the nonresponse plus nonword response percentages. Nonword responses were subject attempts which could not be recognized as an English word. It was impossible to know whether subjects were satisfied with their responses in this latter scoring category or whether they recognized that their response did not make a word. Consequently, the percentage of nonresponse (blanks) was taken as best available measure of <u>experienced</u> difficulty for each stimulus. (Nonword responses did not exceed 5 percent for any stimulus skeleton included in the experimental series.)

It was also desired, as mentioned above, to eliminate those stimuli subject to large "order" effects, since a constant rather than a random ordering was to be maintained in the experimental presentation of stimuli. Each category stimulus appeared on two lists in a different position, making available two independent estimates of the probability of category response. A statistical test was made, for each stimulus, as to whether the two sample proportions could have been obtained from a population having the same probability of category response and might, therefore, be legitimately combined into a single estimate of standardized response probability. An appreciable difference between sample proportions would indicate order effects of a magnitude that would make that item unsatisfactory for inclusion in the experimental series.

A test of the two-sided alternative (that either sample proportion is larger than the other) was made in terms of the standardized normal variable by means of the test, "Comparing Two Sample Proportions" (Wallis & Roberts, 1956, pp. 429-431). The results of this test appear in Appendixes A and B.

Those stimuli for which the probability was $<.20$ that the two sample proportions had come from a single population (in terms of category response percentage) were discarded as subject to "too large" order effects. While the choice of the .20 cutting point was, in a sense, arbitrary, it was dictated by the necessity of retaining enough stimuli to conduct the experiment. It is not contended that order effects have been eliminated but merely that they have been reduced insofar as possible.

Sample proportions were then combined to obtain estimates for the remaining 67 skeletons which are shown in Appendix C. Stimuli are listed in order of decreasing probability of category response. An estimate of ambiguity has also been calculated for each stimulus, and this is included in Appendix C. The more the probabilities of category and noncategory responses approach each other, the more ambiguous the stimulus becomes. The measure of ambiguity adopted was, therefore, the difference between percentage of category response and percentage of noncategory response.

Since it was also desired that the difficulty (probability of nonresponse) not differ greatly from one part of the experimental series to another, this information (presented in Appendix C) was also utilized in the final selection of stimuli for this study.

It was also considered desirable to estimate whether, or to what extent, the standardization procedure had induced a set for category words, since category responses were possible to fully half the items responded to by each subject. Although no subject gave as many as sixty category responses, all subjects gave a considerable number, and it seemed likely that, particularly for stimuli appearing later in the lists, some positive expectation for category words might have been induced by prior category responses. If this were true, biased response probabilities for at least some stimuli would be indicated.

A number of tests for selective set were possible under the circumstances. As a test on those stimuli most likely to show such effects, the stimuli were selected which had, by chance, appeared in the first fourth on one list and the last fourth on the other. There were fourteen such instances. The "Signed Rank Test" (Wallis & Roberts, 1956, pp. 596-598) was used to determine whether a higher percentage of category responses was associated with the later appearance of the same stimulus than with the earlier. The smaller rank total was 47.5. At $\underline{n} = 14$, a rank total ≤ 21 is required for significance at the .05 level of confidence.

The possibility remains, however, that a milder set may have existed over all the stimuli and might not have been revealed at $\underline{n} = 14$ for the most extreme items. To test this possibility, all stimuli were used. Category response percentages were compared for those skeletons appearing in the first half of the list and those appearing in the last half of the list, using the "Rank Order Test" (Edwards, 1954, pp. 417-422). The difference in rank totals was only 2, indicating again, no operation of selective set.

As a final check, the more ambiguous skeletons (between 25 and 75 percent category responses) were selected from the above items as more likely to reveal selective set. The same statistical test resulted in a smaller sum of rank differences = 44, which is associated with no difference of measures with $\underline{P}$ .60. It was concluded, therefore, that no selective set for category responses was operating in the standardization procedure and that the standardized category response probabilities provide an estimate unbiased by selective set. This concurs with a similar finding in the previous study (Postman & Crutchfield, 1952) utilizing a similar standardization procedure.

Finally, as a check on the standardization procedure, the determined probabilities of category response for the 67 stimuli listed in Appendix C were divided into previously-used and newly-constructed groups. There were 39 stimuli previously standardized but unfortunately only broad ranges of response probabilities are given in the published report and a correlation could not be computed. However, a rough comparison was possible. Of the four skeletons with an estimated probability of category response near 1.00 in the previous study, the present standardization resulted in a mean estimate of .88. In this instance, and in several others, the difference might be expected in terms of the subjects for which the probabilities were standardized. The particular stimulus responsible for this discrepancy was lun_ _ (to which the category response is "lunch"). For the sample of "Easterners" in the previous study, the probability was approximately 1.00, but for the present sample of "Southwesterners" (for whom the noonday meal is still often "dinner") the probability was only .69.

For the 13 skeletons earlier found to fall between category response probabilities of .01 and .10, the present mean estimate was .13 (with nine falling in the expected range and none higher than .17). For the 10 skeletons falling in the expected range of .21 - .35, the present mean estimate was .38, and for the 12 skeletons falling in the expected .41 - .80 range, the present mean estimate was .595. There is, then a high degree of correspondence between the category response probability estimates of the previous and present standardizations, providing by means of this external check some additional confidence in the standardization procedures used in the present experiment.

The 45 category skeletons selected for use in this experiment from those available in Appendix C are shown in Table 1 in eight sets of ten each. Some category skeletons appear in more than one set, though not in any two sets responded to by the same subject. Category skeletons have been supplemented with 17 noncategory skeletons according to the requirements of the experimental design.

Noncategory skeletons were chosen from those used in the standardization lists as "padding"--to avoid induction of an

Table 1

Sets of Stimuli Utilzed in Experimental Procedures

Page[a]	Set	Category Items	Skeleton Words
1	1a		p r _ b l _ m
			s t _ d _ u m
			u _ i v _ r s e
			c o _ p _ n y
			f _ n g _ r
			y e l _ o _
			v _ c a t _ o n
			b _ _ k
			_ _ f i c i a l
			w _ _ k
1	1b	c	l e _ _ u c e
		c	k i _ c h _ n
		c	b _ n _ n a
		c	d _ s s _ r t
		c	k e t _ l _
		c	g r a p e _ _ u i t
		c	c _ _ k i e
		c	c a _ _ a g e
		c	_ u r n _ p
		c	a s p a r a _ u _
1	1c	c	l e _ _ u c e
		c	k i _ c h _ n
		c	b _ n _ n a
		c	d _ s s _ r t
			p r _ b l _ m
		c	k e t _ l _
		c	g r a p e _ _ u i t
			y e l _ o _
		c	c a _ _ a g e
		c	c _ _ k i e

Table 1 (Continued)

Sets of Stimuli Utilized in Experimental Procedures

Page[a]	Set	Category Items	Skeleton Words
2	2	c	h _ n g _ r
		c	s a l _ _
		c	s _ _ c e
		c	p e _ _ e r
		c	b _ e _ d
		c	_ e _ f
		c	_ a k _
		c	_ a _ o n
		c	t _ a _ t
		c	s _ e _ k
3	3	c	p _ _ m
		c	b r _ n _ h
		c	b _ _ t
		c	_ a _ i n g
		c	_ _ s t e r
		c	_ r a _
		c	_ _ o k
		c	s _ l _
		c	_ r i p _
		c	s _ _ w
4	4	c	_ i n _
			h _ s b a n _
		c	_ e _ d
			a _ _ e m b l y
		c	_ i c _
			s t _ g _
		c	h _ s _
			c _ _ t
		c	p _ r _
			e a _ _ h

Table 1 (Continued)

Sets of Stimuli Utilized in Experimental Procedures

Page[a]	Set	Category Items	Skeleton Words
5	5		c _ l l _ g e
			w _ n d _ w
			_ u c c e s _
			_ _ c o r d
			m _ r d e _
			r _ s _ r t
			g r _ _ p
			d _ l _ a r
			s k _ l _
			p o _ i c _
6	6	c	_ _ a v y
		c	b e _ _
		c	v _ _ l
		c	_ a _ e
		c	_ u t _ e r
		c	h _ n _ e r
		c	s q u _ s _
		c	m _ a _
		c	s p _ _ n
		c	f i _ _

[a]"Page" refers to the order of presentation of stimulus sets to subjects in all experimental groups. Page 1 varies (sets 1a, 1b, and 1c) according to procedures described below. All subjects experienced the same stimuli on pages 2, 3, 4, 5, and 6.

expectancy for category stimuli. Those listed above in Table 1 were chosen by three criteria: remoteness of food associations, relative ease for subjects (difficulty or nonresponse < 5% on all used), and in order to "mix them up," *i.e.*, to avoid inducing expectations of some new category in the process of invalidating expectations of food-related items. These items are all those of Sets 1a and 5, pr_bl_m and yel_o_ on Set 1c, and h_sban_, a__embly, st_g_, c__t, and ea_h on set 4. Their contribution to mean category response probabilities shown in Table 2 is zero.

Table 2

Standardized Mean Response Probabilities of the Experimental Sets of Skeleton Words[a]

Set	Category	Noncategory	Difficulty
1 a	.00	> .95	< .05
1 b	.92	.00	.04
1 c	.75	.19	.03
2	.36	.37	.18
3	.13	.69	.12
4	.02	.87	.08
5	.00	> .95	< .05
6	.43	.39	.10

[a]Mean response probabilities do not total 1.00 since non-word responses have been excluded for reasons described above.

Standardized response probabilities for stimuli have been combined to provide mean estimates of stimulus characteristics of the sets of ten skeleton words. These appear in Table 2. The manner in which these sets of standardized stimuli were ordered and presented to subjects is specified in detail in the section on procedure.

Two estimates of mean ambiguity of the stimulus sets are presented in Table 3. Entries in the "Mean of Differences" column were obtained by computing the difference between probability of category response and probability of noncategory response for each

Table 3

Measures of Mean Ambiguity (Equiprobability of Category and Noncategory Response) of the Experimental Sets of Skeleton Words

Set	Mean of Differences	Difference Between Means
1 a	1.00[a]	1.00[a]
1 b	1.00[a]	1.00[a]
1 c	1.00[a]	1.00[a]
2	.18	.01
3	.55	.56
4	.87	.85
5	1.00[a]	1.00[a]
6	.49	.04

[a]These estimates of 1.00 or minimal ambiguity, result from the impossibility of both category and noncategory responses to any one skeleton in the set.

item in a set, adding these figures, and dividing by 10. Entries in the "Differences between Means" column are differences between the mean probabilities of category responses and noncategory responses as shown in Table 2, for each stimulus set. For both estimates, the smaller the table entry, the greater the mean ambiguity of the set in this special meaning of ambiguity.

Although the absolute magnitudes of these estimates differ, both show the necessary trend from ambiguity on Set 2 skeletons to increasing clarity or certainty of noncategory response over Sets 3, 4, and 5. The striking difference between the two estimates of ambiguity on Set 6 was occasioned by the necessity of using in this set the remaining stimuli which were less ambiguous than those used in Set 2. That is, equiprobability of category and noncategory response to the set was obtained for Set 2 primarily by choice of skeletons with about equal probability of category and noncategory response. In set 6, it was obtained more by choosing equal numbers of stimuli to which category response probabilities were relatively high and relatively low.

Procedure

A particular packet of six sets of ten skeleton words each was responded to by subjects according to the experimental (or control) group to which each subject was assigned. Each set of ten stimuli appeared on a single, mimeographed sheet along with the appropriate instructions for responding to the stimulus materials. Six sheets were stapled together in specified order (see Table 4) to make a packet appropriate to each of the conditions.

Table 4

Sets of Stimulus Materials Composing Stimulus Conditions for Experimental and Control Groups

Group	page 1	page 2	page 3	page 4	page 5	page 6
Control	1a	2	3	4	5	6
Deductive-All	1a	2	3	4	5	6
Deductive-Most	1a	2	3	4	5	6
Inductive-All	1b	2	3	4	5	6
Inductive-Most	1c	2	3	4	5	6

Following general instructions for all subjects (see below), these packets of stimulus materials were distributed to subjects in intact classes. The five experimental packets were distributed in mixed order, so that subjects sitting next to each other would respond to different, group-specific instructions and stimuli in order that independence of results from different subjects in the same classroom might be maximized. This procedure offered the additional advantage of controlling for any factors relating to particular classroom groups of subjects since all experimental conditions were represented in the responses of each classroom group.

The relevant motivational factor with respect to the stimuli utilized in this experiment was hunger. In order to control for any differential effects of this variable, only "between-meals" classes were used--9:00 and 10:00 A.M. and 2:00 and 3:00 P.M.--as in the stimulus standardization procedures.

The general instructions given orally to all subjects prior to distribution of stimulus materials were as follows:

> I'll ask you to take just a few minutes to help me with an experiment on reading--or maybe better, on reading materials. You are not being tested. You are testing the reading materials. Consequently, do not put your names on your papers.
>
> At the moment, I'm just trying to find out how much of a printed word people really need to see in order to know what the word is, whether some words are easier to recognize than others, and whether it helps to have an idea of what kinds of words to expect.
>
> I will hand you some sheets, stapled together, on which there are some "skeleton" words--that is, words with some letters missing. For example, if I write (demonstration on blackboard) W _ L K, you may recognize it as "walk," and if I write T _ _ K, you may see "talk." Now, if you came into a classroom and saw this on the board, what would you read? N _ C L _ _ _ T _ D _ Y (waiting for subject responses, "no class today.") I'm kidding, of course, but it does show that you really don't need to see very much of a word or phrase to recognize what it is.
>
> On the sheets of skeleton words that I will hand you, there are ten words on each of six sheets stapled together. I'll ask you to complete the skeletons in order by filling in the missing letters. That is, on each separate sheet, fill in the words in any order you like, but once you have gone on to the next sheet, please do not turn back to any sheet you have finished.
>
> Each of you will get a somewhat different set of skeletons. The instructions for going about the task

> are printed on the sheets with the words, and they will also be different for different people. In other words, the person on each side of you has somewhat different skeletons and instructions. So just read the printed instructions on your sheets and complete your skeleton words. Resist the natural temptation to check with your neighbor till everyone finishes.
>
> Don't worry about spelling. Just come as close as you can. If you come to a word you don't know, just pass it and go on.
>
> Are there any questions? (Waiting for questions) If you should have a question after you start, hold up your hand and I will come to you so as not to disturb the others.

Printed at the top of each mimeographed first sheet were additional general instructions which were the same for all subjects:

> INSTRUCTIONS: Insert letters in the blanks to make English words of the following "skeleton" words. Two letters are needed to complete each word. Avoid slang and proper names. Give the first solution that occurs to you and work rapidly.

At the bottom of each sheet except the last, in all packets, were instructions to continue on to the next page and a request that subjects <u>PLEASE</u> <u>DO</u> <u>NOT</u> turn back to any previous sheet. At the bottom of the last sheet in each packet were instructions to turn the packet over and wait quietly for other subjects to finish. Special instructions for Deduction and Induction subjects, printed at the top of first and second sheets, appear below in connection with description of experimental conditions for the various groups.

Special instructions designed to produce a concept deductively in two degrees of strength were printed below the general instructions at the top of page one and at the top of page two. On page one appeared:

> The words on this sheet are to give you some practice.

At the top of page two the following appeared for Deduction-All subjects:

> You are given a HINT about the "skeleton" words to follow. ALL of the words on this sheet and on the sheets to follow have to do with FOOD and EATING.

Special instructions for Deduction-Most subjects were the same except for the substitution of "MOST" for "ALL."

Inductive concept production instructions appearing below the general instructions at the top of page one were as follows:

> A HINT is contained in the words below as to the class or kind of words to be found on each of the following pages.

No special instructions were given at the top of the second page for Induction subjects. The concept was induced in All and Most strengths by "forced" response to ten of ten and eight of ten category items, respectively, on page one.

Control subjects responded to the same set of "practice" (noncategory) skeletons as Deduction subjects, *i.e.*, no concept was induced. Nor was a concept produced deductively by instructions. Control subjects were then exposed to the same subsequent sets of stimuli as all other subjects. The ambiguous (Set 2) stimuli constituted the test of initial concept strength and might be expected, in themselves, to induce a mild expectation for category words, since ten of ten category responses were *possible* to this set, though not probable. If this occurred for some subjects, subsequent response to the same discrediting and reinstating stimuli experienced by experimental group subjects would reflect the influence through category responses elevated above those indicated in standardization data. The control group made possible an evaluation of any tendency toward concept induction by the concept-strength test itself and these data are presented in connection with Hypothesis 1 results below.

A general description of experimental procedures would, then, be as follows: Concepts were produced inductively or deductively in experimental groups of subjects and in two strengths within each of these groups (Set 1 stimuli or instructions). Concept strength was tested (ambiguous Set 2 stimuli); was discredited (Set 3, 4, and 5 stimuli); and an attempt at reinstatement of the concept concluded the experimental conditions (Set 6 stimuli). Control subjects experienced the same conditions as experimental subjects, except that <u>no</u> concept was intentionally produced inductively or deductively prior to test of concept strength on Set 2 stimuli.

The experimental measure employed was proportion of responses made to each set that were category items. For all subjects, Set 2 stimuli constituted the test of initial concept strength. Presumably, the stronger the concept the higher the proportion of skeleton words on this ambiguous set that would be seen as category items. Stimulus Sets 3, 4, and 5 represented progressively decreasing category response probabilities. They were used both to discredit or invalidate the concept and to provide a measure of concept strength at each point in the course of change. Set 6 items were ambiguous items included to provide a measure of the relative difficulty of reinstating the discredited concepts.

Prior to the test of initial concept strength (Set 2 stimuli), Induction subjects had responded to ten skeleton words (eight or ten of which were category items--Stimulus Sets 1b and 1c, respectively). Control and Deduction subjects also responded to ten skeleton words prior to the test of initial concept strength--in these instances Stimulus Set 1a, which was approximately equivalent in difficulty to sets 1b and 1c. All subjects were, then, tested for initial concept strength after responding to the same number of skeleton word stimuli.

As an additional check on correspondence of deductive and inductive procedures, a small independent group of 42 subjects was exposed to All (16 subjects) and Most (26 subjects) expectation-producing conditions, Induction procedure only. It had been desired to approximate inductively the effects of deduction (given in instructions) of the form "All _X_s are _Y_s" and "Most _X_s are _Y_s." Response to the ambiguous test stimuli (Set 2) by pretest subjects indicated this might be roughly accomplished by "forced response to ten of ten and eight of ten instances, respectively, in which _X_s (skeleton words) were _Y_s (category items). No doubt, 80 of 100 and 100 of 100 would be preferable, but practical time considerations and boredom effects limited the number of induction items that could be employed.

The 42 subjects referred to above were asked to complete the skeleton words on Set 1a or Set 1b and to write answers sequentially to the following questions: What class or kind of words were on the sheet? What percentage of them were of this kind? What percentage of them had to do with food and eating? Choose one of the following words to describe the proportion of them having to do with food and eating: All, Most, About Half, Few, None.

Of the 16 subjects exposed to ten category items, all completed ten. Five subjects volunteered a category label equivalent to that used in instructions to Deduction subjects, e.g., "foods or connected with such," "food and where it is prepared," "words having to do with things in the kitchen." Eleven subjects volunteered "food" as a category, possibly indicating use of a narrower category than was desired. However, it may be that the label was narrow but the actual category used was not, since three of the eleven estimated that 100 percent were "food" words, apparently including "kitchen" and "kettle" in the category as foods.

For those subjects exposed to the All-Induction conditions, the mean estimate of items falling in the category they had supplied was 84 percent, indicating some use of the narrower "food" category. The mean estimate of items falling in a "food and eating" category was 96 percent. Of the 16 subjects, 13 chose "All" as describing the proportion of items having to do with "food and eating," while two chose "Most," and one chose "About Half."

Of the 26 subjects exposed to the Most-Induction conditions--eight category and two noncategory items--ten subjects supplied categories essentially equivalent to "having to do with food and eating," and 16 listed "food" as the category. Their mean estimate of the items fitting the category they had supplied was 61 percent. The mean estimate of items fitting the "food and eating" category was 79 percent, and 24 of the 26 chose "Most" as descriptive of the proportion of such items, with one subject choosing "All" and one choosing "About Half."

The approximation of All and Most expectations for category items produced by these experimental procedures was then quite good when subjects used the intended category. However, some of these subjects used a probably narrower "food" category, resulting in a depression of the level of expectation below that desired. It would have been desirable to use "food" items exclusively had enough been available. Postman and Crutchfield (1952) were unable to locate enough items for their experiment in the narrower "food" category, and even the extensive additions to their items in the present standardization failed to supply enough items for this desirable restriction.

CHAPTER III

RESULTS

Subject responses were scored as category, noncategory, and nonresponse (including nonword responses). Records of the control group subjects and the various experimental group subjects were separated, and the responses were tabulated for each of the six sets of ten stimuli. Frequency distributions of these raw scores are presented in Appendix D.

It was desired to construct a figure for visual presentation of the pattern or course of concept change. This could be done in at least two different ways. On the one hand, proportion or percentage of possible responses that were category responses might be taken as a measure of the concept. The number of category responses made per set would amount to the same thing, since stimuli per set was always ten. On the other hand, proportion of responses actually made which were category responses might be taken as the measure, and this latter measure seems preferable for the following reason: Nonresponse is a confounded measure including effects of both (a) lower vocabulary, spelling ability, motivation, cooperation, etc. (associated with individuals), and

(b) any inhibitory effects of strong expectations on incompatible responses--here, noncategory words (associated with experimental groups).

Choice of the proportion of responses actually made that were category responses provides a statistical control for this confounded factor. This experimental measure was derived from the raw data in Appendix D for each stimulus set responded to by each subject, and frequency distributions of these data are presented in Appendix E. From these data were constructed the plots of concept change presented in Fig. 1.

Systematic differences in nonresponse (including nonword responses) associated with experimental conditions are dealt with below in connection with particular hypotheses. Experimental measures were utilized which are appropriate to an attempt to separate effects of concepts (expectations) on response suppression and perceptual selectivity.

Statistical tests by analysis of variance appear most appropriate to these data and hypotheses. However, the nature of these data (proportions) and the experimental procedures (tending to produce bimodality only under certain of the experimental conditions) raise doubts as to whether the parametric analysis of variance can be utilized on untransformed scores. Inspection of both raw and derived data in Appendixes D and E indicates probable violation of assumptions of normal distribution and homogeneity

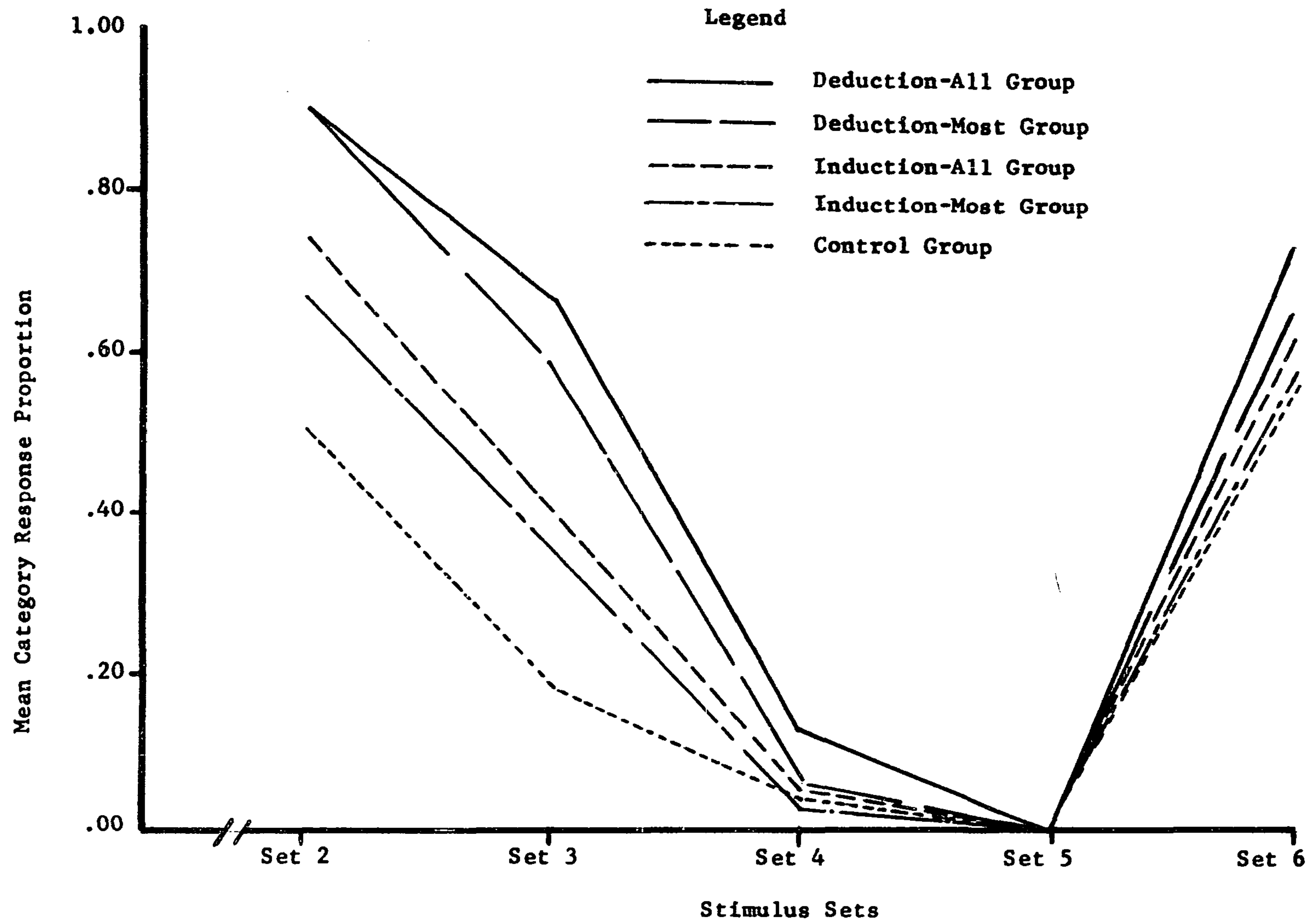

Fig. 1. Mean category response proportions to stimulus sets 2 through 6, total samples of experimental and control group subjects (Data from Appendix E).

of variance. Since it seemed desirable to use tests of comparable power or efficiency throughout the analysis of these data, at this point a decision was made among alternatives of consistently analyzing untransformed data or transformed data with parametric techniques or of resorting to nonparametric or distribution-free tests.

Variances were computed from experimental measures of the various subgroups, and the Hartley test and Bartlett test for homogeneity of variance (Walker & Lev, 1953, pp. 191-194) were performed. Both tests indicated significant heterogeneity of variance. Therefore, data were transformed using transformations recommended (Walker & Lev, 1953, pp. 423-424) for normalizing distributions of proportions. The same tests again indicated significant heterogeneity of variance, and bimodality of some distributions remained.

The decision was therefore made to utilize nonparametric tests of the "median test" or "ranked data" kinds throughout the analyses.

Hypothesis 1

Data from all subjects were used in tests of this hypothesis. Since the prediction was greater initial concept strength resulting from Deduction than from Induction procedure, the relevant data were category response proportions to the Set 2 stimuli immediately following concept production. It should be noted, again, that the prediction was limited to the conditions of the present experiment and that it obviously cannot be argued from positive findings that all deductively-derived concepts are stronger than all inductively-derived concepts.

An extension of the "median test" was employed as described by Wilson (1956):

> Rao has shown that a chi-square statistic for a contingency table can be decomposed into components in much the same manner as a total sum-of-squares is decomposed in analysis of variance computations. By making a relatively simple modification of Rao's technique, it is possible to use this type of analysis in making a distribution-free (*i.e.*, nonparametric) test of the hypotheses concerning main effects and interaction ordinarily tested by a two-way (or two factor) analysis of variance (Wilson, 1956, p. 96).

The value which exactly dichotomizes the combined scores of all the experimental subjects (Set 2 stimuli) was .85. Scores from the 280 experimental subjects were employed in this test--140 of which fell at or above .86, and 140 of which fell at or below .83. Scores (category response proportions) were separated at the common median for each experimental subgroup--$n = 90$ in each Induction group and $n = 50$ in each Deduction group. The resulting frequencies are presented in Tables 5 and 6.

By Wilson's (1956) formulas, chi-square for total was 60.40. Chi-square for Production Method was 29.90 ($P < .001$) and chi-square for Strength was 0.24 ($P > .70$). Chi-square associated with interaction of Production Method and Strength variables, by subtraction, was 30.26 ($P < .001$). All chi-squares had one degree of freedom.

Table 5

Contingency Table for Experimental Groups, Category Response Proportions above the Common Median on Ambiguous Test Stimuli (Set 2)

Strength	Production Method		Totals
	Deduction	Induction	
All	40	32	72
Most	41	27	68
Totals	81	59	140

Table 6

Contingency Table for Experimental Groups, Category Response Proportions below the Common Median on Ambiguous Test Stimuli (Set 2)

Strength	Production Method		Totals
	Deduction	Induction	
All	10	58	68
Most	9	63	72
Totals	19	121	140

Hypothesis 1, then, receives support at $\underline{P} < .0001$. The Deduction procedure resulted in stronger concepts, as measured by responses to ambiguous test stimuli, than did the Induction procedure. The mean response proportions associated with this significant difference were .899 for Deduction subjects and .699 for Induction subjects. See Table 7 for mean category response proportions of experimental groups.

Table 7

Mean Category Response Proportions for Experimental Groups on Ambiguous Test Stimuli (Set 2)[a]

Strength	Production Method		Totals
	Deduction	Induction	
All	.897	.737	.794
Most	.905	.662	.747
Means	.899	.699	.770

[a]For comparison, the mean category response proportion for control group subjects on Set 2 stimuli was .500.

The Strength variable was not significant; the All procedure did not produce consistently stronger concepts than the Most procedure. The effect was, however, in the expected direction--the mean response proportions being for All-subjects, .794, and for Most-subjects, .747. The significant interaction sppeared to involve mainly the exceptionally high mean response score of Deduction-Most subjects which is discussed below.

Since experimental procedures were intended to produce two initial response levels--All and Most expectations--additional tests were desirable to determine whether Deduction procedures resulted in significantly higher response proportions than Induction procedures, at each level. The significance of the Strength variable could have been accounted for by a highly significant difference at only the All, or only the Most, level.

The median test for two groups (Edwards, 1954, pp. 387-390) was employed for this purpose. Deduction-All subjects exhibited significantly stronger concepts initially than Induction-All subjects--Chi-square = 23.67, with one degree of freedom, $\underline{P} < .001$. Also, Deduction-Most subjects exhibited significantly stronger concepts initially than Induction-Most subjects--Chi-square = 32.74, with one degree of freedom, $\underline{P} < .001$. Hypothesis 1, then, received full support.

It was expected that Induction subjects would frequently fail to reach the intended level of expectation, and a larger number of these were included in the sample, so as to provide a statistically adequate number that did reach the intended level. It was also expected that some few subjects exposed to Most procedures would adopt the "gambling orientation" reported by Bruner, Goodnow, and Austin(1956, i.e., would expect all, rather than most, items to be category items. That a surprisingly large number did so under Deduction-Most conditions (actually, 26 of 50) is attested by the significant interaction, and by the high response proportion (.900) under these conditions. The all expectation was also seen under Induction-Most conditions (13 of 90 subjects) but in smaller degree.

Before proceeding to analysis of data in connection with the other hypotheses, two questions remain to be explored: (1) Did Control subjects develop an expectation for category items as a consequence of the test of initial concept strength? (2) Did experimental subjects develop a stronger concept than Control subjects?

The Control subject data presented in Fig. 1 are proportions of responses made which were category responses on each stimulus set. Comparable standardization subject data are not available since stimuli were not combined in sets of ten in the standardization procedure. Therefore, the Control subject data comparable with standardized response probabilities (Table 2) is percentage of possible responses which were category items. These are presented below in Table 8 with associated response possibilities.

Table 8

Category Response Proportions Compared for Stimulus Sets 2 through 6; Possible, Probable, and Achieved

Stimulus Set	Possible	Probable (Standardization)	Achieved (Control Group)
2	1.00	.36	.40
3	1.00	.13	.15
4	.50	.02	.04
5	.00	.00	.00
6	1.00	.43	.51

Although category response percentages are higher for Control than Standardization subjects on Stimulus Sets 2, 3, and 4, they are only slightly so. Since stimulus presentations were not comparable for these groups of subjects, no statistical test of the difference is reasonable. However, it should be mentioned that noncategory response proportions for Control subjects (39%) were also higher than those for Standardization subjects (37%) on Set 2 stimuli.

It may be that response percentages for both category and non category items were increased for Control subjects by virtue of greater alertness. They responded to fewer stimuli than Standardization subjects. However, since response percentages of Control subjects were also higher on Stimulus Sets 3, 4, and 6, it would appear that some mild degree of expectation for category items may have been induced by the Set 2 stimuli which constituted the initial test of concept strength.

Finally, to test whether Experimental subjects developed a stronger expectation for category items than Control subjects, a median test for two groups was performed (Edwards, 1954, pp. 387-390) on Set 2 category response proportions of these groups of subjects. Chi-square was 24.87 which, with one degree of freedom, is associated with $\underline{P} < .001$, which supports the view that Experimental subjects developed stronger concepts than Control subjects as a consequence of the concept-formation procedures to which they were exposed.

Table 9 summarizes the statistical comparisons made in connection with tests of Hypothesis 1.

Hypothesis 2

Following the test of initial concept strength using Set 2 stimuli, all subjects experienced identical stimulus conditions designed to discredit or invalidate the experimentally-produced concepts. Subjects responded sequentially to Stimulus Sets 3, 4, and 5, each set having a decreasing probability of category response. Furthermore, no more than 50 percent category responses were possible to Set 4, and no category responses were possible to Set 5. See Tables 2, 3, and 8 for specification of

Table 9

Summary of the Results of Median Tests Performed in Connection with Hypothesis 1

Variables	Chi-Square	Degrees of Freedom	Probability
Total[a]	60.40	1	-
Production Methods[a]	29.90	1	< .001
Strength[a]	0.24	1	> .70
Interaction[a]	30.26	1	< .001
Deduction-All vs Induction-All[b]	23.67	1	< .001
Deduction-Most vs Induction-Most[b]	32.74	1	< .001
Control Group vs Experimental Groups[b]	24.87	1	< .001

[a]Wilson's (1956) median test of analysis of variance hypotheses.

[b]Two-group median test (Edwards, 1954, pp. 387-390).

experimental conditions imposed.

Subject responses to these stimulus conditions can be seen in Appendix E and in Fig. 1. The dwindling probability and possibility of category response is reflected in decreasing category responses and increasing noncategory responses made by Control

Group subjects and subjects of all Experimental Groups. Experimental Group subjects had been led, in one way or another, to expect category items "on each sheet." No Experimental subject made any category responses to Set 5 stimuli, and each Experimental subject made some noncategory responses to Set 5 stimuli (see Appendix E). Since this pattern of response is incompatible with the continuing expectation for all, most, or even some category items on each sheet, it can be assumed that the experimentally-produced concepts had been discredited or invalidated at this point in the experiment. Hypothesis 2, therefore, appears tenable in view of these data.

Stimulus Sets 3, 4 and 5 served the dual purpose of discrediting expectations for category items and providing a step-by-step measure of concept strength during the course of the change. It was shown in connection with Hypothesis 1 that Experimental subjects developed a stronger concept initially than Control subjects. It would seem reasonable to expect, then, that this significant difference might continue on Set 3 but might well decrease or disappear on Set 4, that is, before such a difference became an impossibility on Set 5.

Median tests for two groups were performed on category response proportions of Experimental vs Control Groups, separately, for Stimulus Sets 3 and 4, and these results are summarized in Table 10 in conjunction with results of a similar test on Set 2 stimuli performed in connection with Hypothesis 1.

Table 10

Summary of Median Tests Performed in Connection with Hypothesis 2

Experimental Group vs Control Group	Chi-Square	Degrees of Freedom	Probability
Set 2	24.87	1	$< .001$
Set 3	36.91	1	$< .001$
Set 4	0.03	1	$> .75$
Set 5	0	1	-

With a possibility of half the items on Set 4 eliciting category responses, a significant difference between responses of Control and Experimental subjects clearly could have occurred. That it did not do so is supportive of the view that Experimental subjects had stronger concepts than Control subjects through Sets 2 and 3, but that it had been discredited by Set 4, that is, even prior to Stimulus Set 5.

Hypothesis 3

The prediction was that <u>when initial concept strength was equated</u>, deductively-derived concepts would be more rigidly held than would inductively-derived concepts, *i.e.*, would be associated with a different specified pattern of change under pressure to change. The pattern of change proposed as defining rigidity was initially greater resistance to change followed by more sudden change. It was also expected, of course, that stronger concepts would be held more rigidly than weaker concepts.

It was necessary to equate initial strength of concepts (expectations) in order to demonstrate that strength, at least as usually measured, does not offer a fully adequate explanation for behavioral rigidity. Even when initial concept strength was the same, it was predicted that deductively-formed concepts would be held more rigidly than inductively-formed concepts.

The experimental measure for purposes of testing this hypothesis was proportion of responses made that were category responses on each of Stimulus Sets 2, 3, and 4. Category response proportions to Set 2 stimuli (the test of initial concept strength) were used to equate initial concept strength at All and Most levels for Deduction and Induction subjects. That is, subgroups of Experimental subjects were selected from those presented in Appendix E so as to meet criteria for method of formation and initial strength of concept. Hypotheses 3 and 4 were tested only in connection with data from these groups, hereafter referred to as <u>criterion subgroups</u>.

The criterion for an "All" initial expectation was a 100 percent category response proportion on Set 2 stimuli. The criterion for a "Most" expectation was a less than 100 percent but more than 75 percent category response proportion on Set 2 stimuli. This latter criterion was chosen to approximate the use of "most" made by pretest subjects on which data are presented at the end of the section on procedure.

Composition of criterion subgroups, in preference to a subject-by-subject matching procedure, necessitated the use of independent sample statistics rather than matched sample statistics. The Deduction and Inductive criterion subgroups are, then, comparable in initial concept strength, separately, at All and Most levels. Control subjects are the total sample of such subjects also employed in tests of Hypotheses 1 and 2.

Data on these criterion subgroups of experimental subjects were extracted from Appendix E, and the mean category response proportions are presented in Table 11. Mean category response proportions on Set 5 stimuli were zero for all groups. Data on Set 6 stimuli are employed in connection with Hypothesis 4 below. Fig. 2 was constructed on the basis of these mean category response proportions.

Although assumptions of parametric analysis of variance were not met by these data, some statistical test more sensitive to differences of magnitude than the "median" tests employed in Hypotheses 1 and 2 seemed desirable. Accordingly, "sum of ranks" tests (Edwards, 1954, pp. 417-430) were employed in testing the predictions of Hypothesis 3.

To test for greater resistance early in the course of change, category response proportions of experimental criterion subgroups on Set 3 stimuli were compared. It was assumed that subjects who

Table 11

Mean Category Response Proportions of Criterion Subgroups of Experimental Subjects and Control Subjects on Stimulus Sets 2, 3, 4, and 6

Group	Stimulus Sets			
	Set 2	Set 3	Set 4	Set 6
Deduction-All (n = 25)	1.00	.730	.112	.688
Induction-All (n = 19)	1.00	.579	.079	.712
Deduction-Most (n = 19)	.863	.498	.052	.704
Induction-Most (n = 27)	.837	.483	.012	.659
Control (n = 40)	.500	.178	.042	.569

produced higher proportions of category responses on this set were exhibiting a greater early resistance to recognizing that their expectations were inaccurate. Tests of the major variables--method of concept production and initial level of concept strength--were performed first.

Category response proportions on Set 3 stimuli were combined and ranked for all experimental criterion subgroup subjects. Rank totals were, for Deduction subjects (All and Most levels combined), 1,788.5, and for Induction subjects (All and Most levels combined),

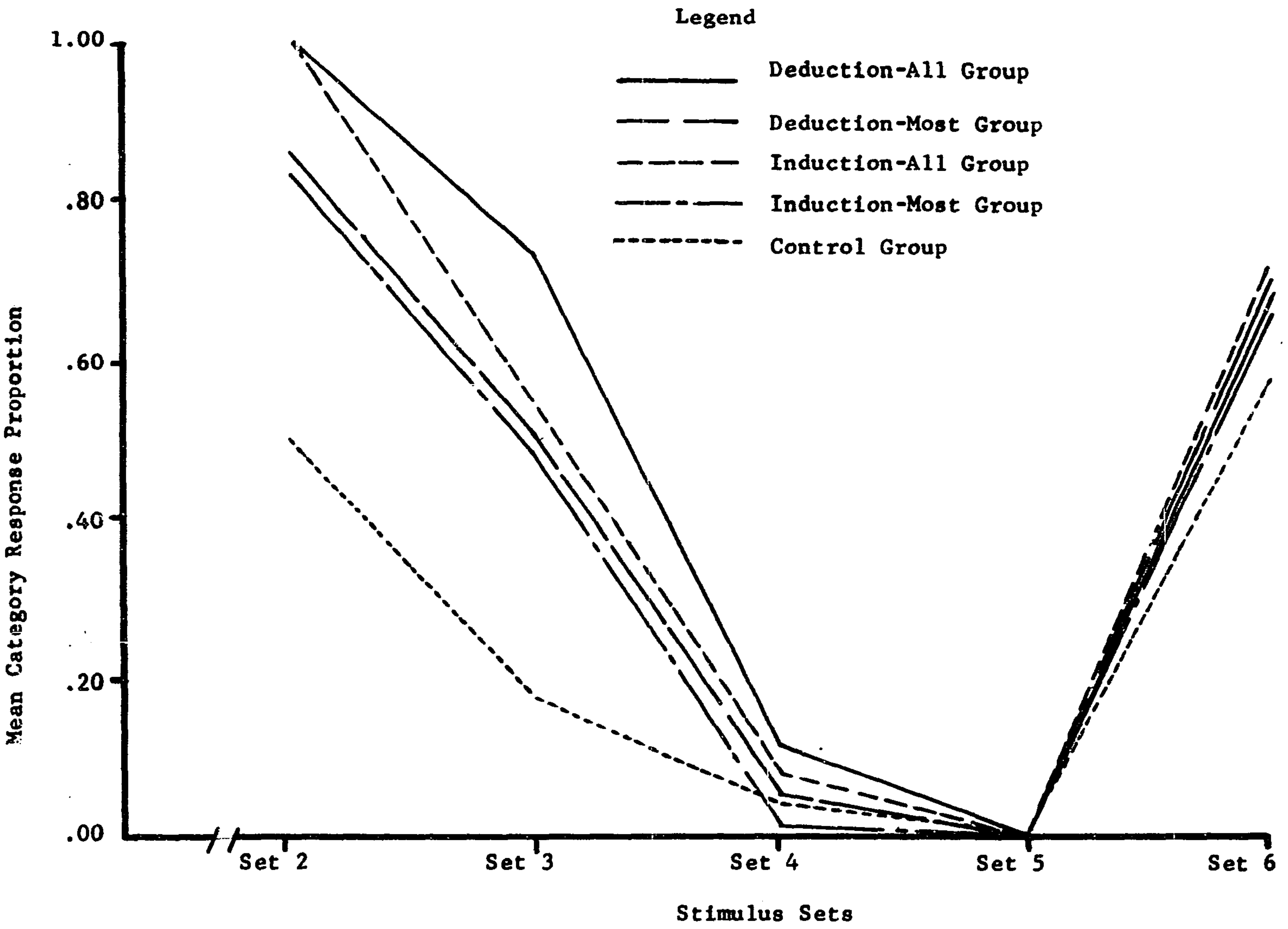

Fig. 2. Mean category response proportions to stimulus sets 2 through 6, "Criterion" subgroups of experimental and control subjects (Data from Table 11).

2,306.5. The smaller rank total indicates greater resistance to change, since Rank 1 was assigned to the largest score. Mean category response proportions were, for Deduction subjects, 0.630, and for Induction subjects, 0.523. Since $\underline{N}$ was large (total $\underline{N}$ = 90), the recommended test by normal curve approximation was made. With corrections for continuity and tied ranks, computed $\underline{z}$ = 1.74, with associated probability .0409 by one-tailed test (since direction of difference was predicted).

To test for effects of the initial concept strength variable, rank totals were calculated: All (Deduction and Induction combined), 1,653.0, Most (Deduction and Induction combined), 2,442.0. Mean category response proportions were, for All-group subjects, 0.665 and for Most-group subjects, 0.489. Computed $\underline{z}$ = 2.84, is significant at $\underline{P}$ = .0023.

Greater resistance to early change is, then, associated with initially stronger concepts and concepts formed deductively. Inspection of Table 11 reveals that on Set 3 stimuli, difference between category response proportions of Deduction-All and Induction-All groups was considerable, but that the difference between Deduction-Most and Induction-Most groups was small. To fully support the prediction of greater early resistance to change of deductively-formed concepts, the differences at both All and Most levels of initial concept strength had to be significant.

"Sum of ranks" tests were again employed in this test. The rank difference between Deduction-All and Induction-All subjects was associated with $\underline{z}$ = 1.422, $\underline{P}$ = .0778, approaching significance. The rank difference between Deduction-Most and Induction-Most subjects was associated with $\underline{z} < 1$--clearly not significant. Hypothesis 3 thus fails to receive full support in this instance.

Inspection of Fig. 2 reveals that Deduction-All subjects were outstanding in resistance to change on Set 3 stimuli as compared with other experimental group subjects. As a test of whether Deduction-All subjects differed from all other experimental subjects in this respect, category response proportions for all subjects were combined and ranked in order to perform a "sum of ranks" test. The rank total for Deduction-All subjects was 800; for all other Experimental subjects, 3,295. Computed $\underline{z}$ = 3.037, $\underline{P}$ = .0012, indicates that the subjects who developed absolutistic expectations deductively were more resistant to change early in the course of change than other subjects who also developed expectations for category items. Table 12 summarizes the results of the above statistical tests.

It might also be reasonably expected that any preconception or expectation, in any appreciable strength and however formed, would be associated with a greater resistance to change than no (or a very mild) expectation. Although it appeared obvious from an inspection of Fig. 2 that such was the case, a "median test" (Edwards, 1954, pp. 387-390) was performed. Chi-square was 44.24 which is associated with $\underline{P} < .001$ at one degree of freedom. Greater resistance to change was exhibited by Experimental subjects than

Table 12

Summary of Resistance-to-Change Results on Set 3
Stimuli by "Sum of Ranks" Tests

Variables	z	Probability
Deduction vs. Induction	1.74	.0409
All Level vs. Most Level	2.84	.0023
Deduction-All vs. Induction-All	1.422	.0778
Deduction-Most vs. Induction-Most	< 1	
Deduction-All vs. Other Experimental Subjects	3.037	.0012

Control subjects as measured by category response proportions on Set 3 stimuli.

Hypothesis 3 predicted greater rigidity of deductively-formed concepts than inductively-formed concepts. It also expected that stronger (All level) concepts would be more rigid than weaker (Most level) concepts. It has been shown above that the stronger concepts were definitely more resistant to change early in the course of change. The effects of deductive concept formation on resistance to change were barely significant and comparisons between Induction and Deduction subjects at All and Most levels of initial strength were not significant. The special case of deductive formation of All expectations (absolutistic concepts) was associated with greater resistance to change than other methods and initial strengths considered together. All Experimental subjects considered together exhibited more resistance to change than did Control subjects who had no (or a mild) expectation for category items.

However, an early or initial resistance to change was only a part of the proposed definition of rigidity. Hypothesis 3 also specified that early resistance would be followed by greater or more sudden change by deductively-formed concepts. It can be seen by inspection of Fig. 2 and Table 11 that variables associated with greater resistance to change on Set 3 stimuli were also automatically associated with greater change between Set 3 and Set 5. This change was intentionally forced by the nature of the stimulus conditions as specified in the experimental design in Chapter II. It completes the pattern of change proposed as defining rigidity--greater early resistance to change followed by greater (or faster) change later.

In life outside the laboratory concept change is not infrequently forced. Reality, in highly structured stimulus situations, may have a compellingness which is not to be ignored. Such situations range from forced regurgitations in home and classroom, through "Negroes are educable," to brainwashing. It is precisely this forced change in concept or expectation, voluntary or not, which the present experiment is designed to examine. Behavioral rigidity under such circumstances is seen in an initial resistance to change followed by change which is compelled by the experienced stimulus situation.

It is therefore concluded, in connection with Hypothesis 3, that any concept (Experimental groups) was associated with greater rigidity than no (or a mild) concept (Control group). Stronger concepts (All-groups) were more rigid than milder concepts (Most-groups). Deductively-formed concepts were more rigid than inductively-formed concepts, though not separately at All and Most levels of initial concept strength. Finally, the most pronounced rigidity was found to be associated with the special case of deductively-formed, absolutistic (All expectation) concepts--a type of concept (expectation) formation of considerable practical and theoretical importance.

Hypothesis 4

Inspection of Fig. 2 and Table 11 reveals that the Hypothesis 4 prediction of greater ease of reinstating discredited, inductively-formed concepts than deductively-formed concepts is clearly not supported by these data. Neither does initial concept strength predict ease of reinstatement of the discredited expectation. Nor are there indications of interaction effects. Although all criterion subgroups of experimental subjects exhibit larger mean category response proportions than the control group, the difference was not significant by median test (Edwards, 1954, pp. 387-390). Chi-square = 1.705, with one degree of freedom, is associated with $\underline{P} > .10$. Hypothesis 4 is, then, clearly not supported by these data.

CHAPTER IV

DISCUSSION OF RESULTS

The results of this experiment which are to be discussed below may be summarized as follows. Concepts (attitudes, expectations, sets, etc.) were produced experimentally in varying strengths and by two procedures--deductively (by means of written instructions) and inductively (by subject response to a series of stimulus items). The deductive method of concept formation resulted in stronger concepts than the inductive method of concept formation used in this experiment. A considerable number of subjects exposed to conditions intended to produce relativistic ("Most" expectation) concepts deductively actually developed absolutistic ("All" expectation) concepts. The experimentally-produced concepts were discredited or invalidated by stimulus conditions which demonstrated with increasing certainty over time and inadequacy of the expectations involved.

Experimental subgroups ("criterion" groups) within these larger groups were composed of those subjects who actually attained the intended levels of concept strength ("All" and "Most" expectations) by each method of concept formation. Effects of initial concept strength, mode of concept formation, and their interaction were assessed in connection with these subgroups of subjects for which initial concept strength had been equated at two levels. Rigidity of concept utilization, as defined by initially greater resistance to change followed by more rapid change, was found to be associated with deductive concept formation, initial concept strength, and most strikingly with the special instance of deductive formation of the strongest concepts. Experimental production of concepts was associated with greater rigidity than the case of no (or mild) concepts of the Control subjects. Finally, an attempt was made to reinstate discredited concepts, but no differences were found in ease of reinstatement between experimental groups or between experimental and control groups.

A finding in this experiment which deserves careful qualification in discussion was the greater strength, under these particular stimulus conditions, of deductively-formed concepts as compared with inductively-formed concepts. In a number of other experiments, under other particular stimulus conditions, the strength of deductively formed concepts has also been revealed (Henle, 1942; Hill, 1953; Postman & Leytham, 1951; Vinacke, 1952; and Walker, 1955). The present experiment adds another bit of evidence along these same lines, but it cannot be concluded from any or all of these that a particular deductively-formed concept will necessarily be stronger than a particular inductively-formed concept. A fruitful direction that research on this topic might take would be indicated in a question such as, "How much of what sort of inductive experience is equivalent to a particular deductive experience?"

In this connection, a theoretical issue is raised with respect to the amount of "information" conveyed by inductive experience as compared with deductive experiences. One implication of the deductive derivation of concepts would appear to be that they are based on "less information" (not necessarily less accurate) than similar, inductively-derived concepts. For example, in terms of quantity of sensory energies involved, being told, "Snails are not good to eat," represents less "experience" than a series of attempts to eat snails culminating in the same, or a similar conception. However, "information" cannot be equated with quantity of external or sensory energies because of redundancy. An additional experience may or may not convey appreciable "information."

It does appear that concepts based on verbal dicta are often supported by less (or less certain or reliable) information about the referent of the concept than those learned in actual contact with the referent, but this need not necessarily be the case. It also seems likely that concepts based on less, or less certain, information might be held more rigidly, when held at all, than apparently similar concepts based on more, or better, information or evidence. However, until some more satisfactory way can be found to quantify "information received" (as contrasted with "information intended"), the question must apparently remain open.

With the summary of results and the above qualifications as a background, discussion will now be focused on three topics: rigidity as a response variable, interaction of motivational and conceptual factors, and the practical and research implications of this study.

Rigidity as a Response Variable

A distinction was proposed, in connection with the present experiment, between "strength" and "rigidity" of concept utilization. It was suggested that "strength" may be a useful attribute at a point in time but that it is inadequate for a full understanding of the functional characteristics of the intervening variables that are variously labeled concepts, attitudes, sets, expectancies, hypotheses, etc. There are a great many experiments in the literature reporting some success in predicting subsequent change or resistance to change on the basis of initial "strength," of inferring "strength" from change or resistance to change (e.g., Buss, 1950; Dittes & Kelley, 1956; Harvey, Kelley, & Shapiro, 1957; Henle, 1942; Hill, 1953; Kelley & Volkart, 1952; Maltzmann & Morrisett, 1952; 1953a, 1953b; and Postman & Crutchfield, 1952). There are also a number of studies reporting success in predicting change from externally-exerted pressures to change (e.g., Ewing, 1942; Goldberg, 1954; Harvey, Kelley, & Shapiro, 1957; and Hovland & Pritzker, 1957). Experiments have also been reported in which "strength" was a factor in a more complex analysis of the functional characteristics of the intervening variable and in which predictions were successfully made of change in intended directions and in the opposite direction (cf., Sherif & Sherif, 1956, pp. 572ff). In a number of theoretical views (e.g., Allport, 1955; Kelley, 1957; Osgood & Tannenbaum, 1955; and Postman, 1951), strength, intensity, energy--some unitary dynamic characteristic--is seen as accounting for change, resistance to change, or "going out of the field."

Validation of "rigidity" as an additional functional characteristic of these intervening variables required, then, a demonstration that concepts, etc. of equal measured strength at a point in time might change differently under pressure to change. It was suggested that this possibility might have been overlooked as a consequence of the customary use of (usually two) point-in-time measures from which the unitary dynamic factor was inferred, and that if changes were examined over time, the necessity of bringing an additional variable into the analysis would be revealed.

The present experiment was therefore designed to approximate the circumstance where various persons holding apparently the same concept in apparently the same strength change in equal amounts, but change in different ways. "Rigidity" was chosen as a label for the pattern of change in which initial resistances collapse under pressure because this is what we seem to mean by "rigidity" in everyday life. We think of a rigid concept, attitude, or expectation as one which appears strong, but is really brittle, fragile, inflexible, vulnerable. "Strength" seems more to imply flexibility or invulnerability. If rigidity is coexistent with strength and confounded with it in point-in-time measures, then some of the inconsistencies in "change" and "resistance" experiments may become understandable.

It was proposed in this experiment that one variable--probably only one of many--associated with rigid utilization of concepts might be the mode or manner of formation of the concept. One obvious difference between methods of concept formation is between inductive and deductive processes, and it was this difference that was chosen for a first attempt at operational separation of "strength" and "rigidity." It was not expected, under these stimulus conditions and at this low level of ego-involvement in an inconsequential task, that an actual collapse or sharp break would be seen following initial resistance but merely that significant trends in that direction might be demonstrated. The findings do indicate clearly that mode of formation interacts with strength to produce a rigidity which is not predictable from strength alone. This result opens the way to further research exploring rigidity as a factor at least partially separable from strength and bringing in other variables thought to influence rigidity into the analysis.

It can, of course, be argued that the simple point-in-time measure used here (and elsewhere) is not an adequate measure of strength, that strength is more complicated, or that there are different kinds of strength. But if the complexities or kinds of strength involve rigidity and flexibility, then the distinction is essentially the one proposed above. An advantage of the definition of rigidity proposed here is that, by its use, intrusion of value judgments may be avoided. By this definition, a rigidly behaving person is not just the one who stubbornly refuses to "see the light," to solve a problem the way <u>we</u> think he should, or to quit disliking members of some human group or groups. He is a person whose initial over-resistance to change is followed by rapid change.

In Chapter I, the controversy raging between proponents of varying explanations of rigidity was mentioned. An attempt has been made, in this study, to avoid the controversy, but the implications of the present experiment should be clear. Although this was a study of behavioral rigidity, it should not be seen as negating intrapersonal consistencies that are demonstrable (<u>e</u>.<u>g</u>., Bruner, Goodnow, & Austin, 1956: Luchins, 1947). For example, a "rigid personality" might be <u>partially</u> conceived in terms of these findings as one consistently associated with the deductive derivation of absolutistic conceptions. Further research along these lines might fill in more of the picture in a more promising way than have speculations about authoritarian fathers and toilet training.

Interaction of Motivation and Conceptual Functioning

From the results of this experiment it can also be concluded that the history of concept formation contributes not only to the content or cognitive characteristics of the concept (here, having to do with category items) but also to its dynamic or motivational characteristics (here, strength and rigidity of expectation). An ahistorical approach might detect a great deal about content and strength but overlook rigidity which was a consequence of the manner in which the concept was formed.

The interaction of these cognitive and motivational components or aspects of the intervening variables labeled concepts, attitudes, expectations, beliefs, sets, etc. is also revealed by these findings. Convenient continua, scales, dimensions are used in experiments to measure or express strength (or other motivational variables), and sometimes subjects of experiments also appear to use such continuously variable scales. But frequently, with human subjects, the logical structure or conceptual nature of the expectation, motive, or attitude seems to make a difference in the motivational or dynamic characteristics themselves. It may be that a fundamental discontinuity or stepwise patterning is introduced into human motivational processes by conceptual functioning.

It was to examine this possibility that "All" and "Most" strengths were introduced in instructions and approximated in inductive experiences provided, rather than just any two differentiable strengths. It frequently seems to make a considerable difference whether a person believes "All *Xs* are *Ys*" or just "Most *Xs* are *Ys*"--to make a difference in his motivations, expectations, and behavior which is not understandable in terms of the possibly small quantitative difference between, for example, believing that all men have souls and that most men have souls. An exceptionless finality often seems to be associated with absolutistic conceptions, whereas relativistic conceptions which differ only slightly in magnitude on a continuous scale seem often to differ a great deal in the motivated behavior to which they lead.

This experiment was purposely designed to avoid forcing subjects who formed their concepts inductively to crystallize those concepts in a rule or principle, *i.e.*, to avoid forcing them to give themselves a dictum or to formalize their induction. An interesting topic for future research is whether it is only arriving at an absolutistic conception deductively that is associated with rigidity or whether giving oneself dicta, formalizing one's own inductions, will also be found to be associated with rigidity. If the latter should be the case, the conceptual nature of the intervening variable will be even more strongly implicated in its motivational characteristics.

Some Practical and Research Implications

A possible implication of the present findings has to do with differential recommendations that can be made for producing changes in concepts, expectations, attitudes, etc. when rigidity as well as strength is known. It is frequently recommended that change can best be accomplished by what may be called successive assimilation--by starting with the person "where he is" and leading him gradually in steps acceptable to him toward some different conception. This procedure certainly has practical merit in many situations, but if it is known, for example, that the concepts to be changed are characterized by rigidity of the sort revealed in this experiment--particularly with strong conceptions given by dictum--then a recommendation of more drastic measures <u>may</u> be in order.

That is to say, if the risk of contrast effects and "going out of the field" is acceptable, it may be possible to produce a given change in rigid concepts by "prolonged pounding" as well as "easy steps." If the view to be changed is absolutistic, and if it could, for example, have been learned <u>only</u> by dictum since there is no evidence on the topic "in this world," then the conception may be a great deal more vulnerable, by virtue of its rigidity, than it would appear to be as measured for strength at any particular point in time. The consequences of producing large contrast effects or having large numbers of people "go out of the field," particularly in an educational setting, should not, of course, be minimized.

To conclude this discussion, some possibly fruitful research extensions of these findings are summarized. As mentioned above, it would be interesting to explore the amount of inductive experience necessary to equal a particular deductive conclusion in "information received" and motivational consequences. It would also appear promising, in exploration of rigidity as separable from strength, to bring different degrees of ego-involvement into the analysis and to assess the contribution of uncertainty, insecurity, or lack of stable anchorages on rigidity of concept utilization. The "disillusionment" effects predicted by Hypothesis 4, but not found in this experiment, might conceivably appear at higher levels of ego-involvement. Somewhat on a tangent, but certainly implied by these findings, would be a search for other motivational discontinuities or step-functions associated with alternative conceptual structurings.

One particular research problem would appear to be especially amenable to exploration by use of stimulus materials and procedures similar to those used here. Deductively-formed, absolutistic concepts were found to be particularly rigid in this experiment. Will erroneously absolutistic inductions that are not formalized by subjects prove to be rigid? If subjects are forced to crystallize or formalize their inductions--to give themselves a dictum--will rigidity result?

Finally, some broad problem areas in psychology for which the results of this experiment may have some implications might be mentioned. Is the finding that deductively-formed, absolutistic concepts are particularly rigid related in any way to the view that directive psychotherapy (deductive?) produces results that are less long-lasting, more vulnerable, than those of nondirective (inductive?) psychotherapy? Is the view that "better" learning is produced by "doing" (inductive) than by "telling" (deductive) related to a greater rigidity of the latter? Are areas of culture that are more resistant to change consistently associated with deductive learning and absolutistic conceptions? These questions deserve exploration with respect to the contribution of inductive and deductive processes and absolutistic and relativistic concepts.

CHAPTER V

SUMMARY AND CONCLUSIONS

Experimental findings and theoretical views on topics of inductive and deductive concept formation and on strength and rigidity of concept utilization were surveyed and summarized. For purposes of converting relevant data into a common terminology, "concept" was used as a generic category of which set, attitude, expectancy, hypothesis, directive state, etc. were taken to be special cases. "Inductive concept formation" was used to refer to instances of direct, step-by-step, sequential experience with the referent of the concept. "Deductive concept formation" was used to refer to learning by dictum, formula, or instructions, and without direct contact with the referent of the concept.

On the basis of this survey of available data several propositions appeared to be worthy of experimental exploration. It appeared that strength and rigidity might be separable functional characteristics or process aspects of concepts. It appeared, too, that rigidity might have been overlooked as a consequence of the consistent use of (usually two) point-in-time measures of strength in studies of concept change and resistance to change. Grounds were also found for predicting that deductive concept formation might be more closely associated with rigidity of concept utilization than inductive concept formation. Rigidity of concept utilization was defined as initial resistance to change of expectations associated with the concept followed by sudden or rapid change.

The general pattern of the experimental design was, then, to produce concepts (expectations that subsequent stimuli would be members of a particular category) deductively (through instructions) and inductively (through subject responses to category items). Concepts were produced in two initial strengths--"All" and "Most" expectations by each method. The resulting concepts were tested for initial strength and were then invalidated or discredited by stimulus conditions designed to demonstrate the inadequacy of the concept with increasing certainty. The resulting pattern of change was examined for rigidity of concept utilization. The experimental conditions concluded with an attempt to reinstate the discredited concept--to detect any disillusionment effects.

The hypotheses formulated for testing were as follows:

1. Under the experimental conditions of this study, deductively-derived concepts are stronger than inductively-derived concepts.

2. Concepts change--are discredited--under the specified stimulus conditions, regardless of initial strength or method

of production.

3. Deductively-derived concepts are more rigid or inflexible under pressure-to-change than inductively-derived concepts of equal initial strength.

4. Deductively-derived concepts, when discredited, are more difficult to reinstate than inductively-derived concepts.

Experimental stimuli responded to by subjects were "skeleton words," i.e., words with some letters missing. The experimental task was filling in missing letters to make words of the "skeletons." The class or category of words for which positive expectations were produced was "food and food-related words." Probabilities of category response, noncategory response, and estimates of difficulty were established for a large sample of stimuli by submitting them to a sample of 370 "standardization" subjects. From these available standardized stimuli were composed lists of ten stimuli to meet the requirements for the experimental design. Experimental subjects were 320 Freshman students enrolled in English courses at Texas College of Arts and Industries.

Subjects forming concepts inductively responded initially to ten of ten (intended "All" level of expectation) or eight of ten (intended "Most" level of expectation) category stimuli. Subjects forming concepts deductively responded initially to ten "practice" noncategory stimuli, and then were instructed, "ALL (or MOST) of the words on this sheet and on the sheets to follow have to do with FOOD and EATING." Control subjects responded to the same set of ten "practice" noncategory stimuli but were not instructed as to what to expect prior to test of initial concept strength.

The test of initial concept strength was composed of the same ten ambiguous stimuli for all subjects--skeleton words that could be completed as category or noncategory items with approximately equal ease. Following this test series, three further sets of ten stimuli were presented to all subjects. These stimulus sets had decreasing standardized probabilities and possibilities of category response and were designed to discredit or invalidate subjects' concepts (expectations), however formed and in whatever initial strength. A set of ten ambiguous stimuli aimed at determining the relative ease of reinstating the various discredited concepts concluded the experimental conditions. The experimental measure derived from responses of each subject was, for each set of ten stimuli, the proportion of responses made that were category responses.

Experimental results fully supported Hypothesis 1, adequately supported Hypothesis 2, partially supported Hypothesis 3, and completely failed to support Hypothesis 4.

The following statements can be made at statistically respectable levels of confidence. The procedure used in this experiment to develop concepts deductively resulted in stronger concepts than did the inductive procedure. Subjects in all experimental groups developed stronger concepts than did subjects in the control group. Procedures which were intended to produce concepts in two strengths actually produced such varied concepts that initial strength did not differ significantly between "All" and "Most" groups. This finding supported the anticipated necessity of composing "criterion" subgroups for use in testing Hypotheses 3 and 4, *i.e.*, selection of subjects who, by each concept-production procedure, actually arrived at the two intended levels of concept strength. It was also noticed, in connection with examination of Hypothesis 1 data, that a surprisingly large number of subjects who formed concepts deductively on the basis of "Most" instructions formed absolutistic ("All" expectation) concepts.

Concepts formed inductively and deductively and in varying strengths were invalidated or discredited, not by telling subjects the expectation was wrong, but rather by subjects responding sequentially to stimulus conditions which demonstrated with increasing certainty the inadequacy of the experimentally-produced concept. Findings were positive with respect to Hypothesis 2, indicating that experimental subjects, as compared with control subjects, exhibited the intended concepts in their responses initially and during the early phases of concept change. However, late in the course of change, responses of experimental and control subjects did not differ significantly--could not, as a matter of fact, by virtue of the nature of the experimental conditions.

Hypothesis 3 involved tests for rigidity of concept utilization and required that the pattern of concept change be examined longitudinally for concepts of initially equal measured strength, formed inductively and deductively and at two initial levels of strength. Experimental subjects exhibited greater rigidity than did subjects in the control group. The prediction that deductively-derived concepts would be more rigidly utilized than inductively-formed concepts received only marginal support. The expectation based on research summarized in Chapter I--that stronger concepts would be held more rigidly--received full support. The experimental group of subjects exhibiting rigidity of concept utilization most strikingly were those who had formed absolutistic ("All" expectation) concepts deductively.

The greater ease of reinstating inductively-formed concepts predicted by Hypothesis 4 ("disillusionment" effects associated with discredited, deductively-formed concepts) was not revealed by these data. Neither did initial concept strength effect ease of reinstating discredited concepts.

Results of theoretical significance were found in connection with tests of Hypotheses 1 and 3. The strength of concepts achievable through deductive procedures was again demonstrated, and a method for comparing deductive and inductive resultants was suggested by these findings. Rigidity, as a characteristic of the pattern of change, was shown to be analytically separable from strength, as measured at particular points in time. Finally, rigidity was found to be mildly associated with deductively-formed concepts and pronouncedly associated with deductive formation of absolutistic conceptions.

These experimental results were discussed in connection with other experimental data and with respect to their implications for theoretical views on inductive and deductive concept formation and strength and rigidity as separable factors. Implications were also explored in connection with interaction of cognitive and motivational factors. Some possible practical consequences of the findings were tentatively suggested, and fruitful directions for subsequent research were outlined.

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APPENDIX

APPENDIX A

Standardization and Test Data on Skeleton Words Constructed for this Study[a]

Skeleton Words	*P* Food Response	*P* Nonfood Response	*P* Non-Response	K[b]	*P*
aspara_u_	.82	.00	.04	.000	> .20
_a_t	.12	.53	.25	1.495	.07
_ _ar	.12	.71	.12	1.339	.09
b_ _t	.19	.72	.07	.853	.20
br_n_h	.14	.70	.12	< .250	> .20
be_a_	.38	.36	.20	1.194	.12
b_r_y	.49	.12	.27	3.157	< .001
cr_cke_	.38	.41	.11	1.374	.08
ca_ _age	.79	.15	.04	.000	> .20
co_ _ee	.76	.02	.14	2.530	.006
c_r_	.08	.79	.07	.957	.17
cel_ _y	.86	.00	.10	1.814	.04
chi_ _en	.73	.00	.11	< .250	> .20
_e_ch	.11	.64	.23	1.104	.14
end_v_	.37	.00	.58	< .250	> .20
grape_ _uit	.94	.00	.06	< .250	> .20

APPENDIX A (Continued)

Skeleton Words	P Food Response	P Nonfood Response	P Non-Response	K^b	P
gr_p_	.49	.49	.02	.916	.17
h_ _ey	.76	.01	.17	< .250	> .20
_ine_pple	.95	.00	.04	1.070	.14
_ir_oin	.63	.00	.32	1.368	.09
_in_	.07	.74	.14	.567	> .20
ket_l_	.99	.00	.01	.000	> .20
ki_ch_n	1.00	.00	.00	.000	> .20
li_bur_er	.76	.00	.20	< .250	> .20
l_m_n	.78	.07	.10	< .250	> .20
le_ _uce	.96	.00	.01	< .250	> .20
mu_ _on	.67	.00	.25	< .250	> .20
m_st_rd	.91	.00	.05	.890	.19
nio	.57	.05	.34	< .250	> .20
_ob_ter	.72	.08	.18	1.078	.14
p_ _m	.24	.67	.03	.627	> .20
p_es_rves	.97	.00	.02	.748	> .20
p_a_	.27	.46	.20	>3.000	< .001
p_ _r	.22	.76	.01	1.661	.05
p_r_	.01	.79	.13	.000	> .20
pot_t_	.80	.00	.16	< .250	> .20

APPENDIX A (Concluded)

Skeleton Words	P Food Response	P Nonfood Response	P Non-Response	K^b	P
r_d_sh	.74	.22	.04	.945	.17
roa_ _	.56	.32	.07	2.334	.01
_ra_	.07	.60	.21	.660	> .20
rip	.08	.64	.18	<.250	> .20
s_us_ge	.80	.00	.17	<.250	> .20
squ_s_	.67	.07	.16	<.250	> .20
s_il_et	.68	.00	.26	1.392	.08
shr_m_	.74	.00	.19	1.828	.04
s_l_	.11	.80	.05	.837	.20
sp_ _h	.64	.10	.12	<.250	> .20
s_ _w	.11	.62	.22	<.250	> .20
t_ _ut	.34	.00	.68	1.928	.03
t_mat_	.79	.00	.20	>3.000	< .001
_urn_p	.88	.00	.07	<.250	> .20
_u_a	.19	.21	.56	1.476	.07

[a]Probabilities do not total 1.00. Nonword responses have been excluded.

[b]Test statistics for "Comparing Two Sample Proportions" (Wallis & Roberts, 1956, pp. 429-431) by means of the standardized normal variable (See Chapter II).

APPENDIX B

Standardization and Test Data on Skeleton Words Adopted from a Previous Study[a]

Skeleton Words	*P* Food Response	*P* Nonfood Response	*P* Non-Response	K[b]	*P*
a_ _le	.49	.46	.04	3.898	< .001
_a_on	.23	.41	.22	.017	> .20
_a_e	.05	.83	.10	-.237	> .20
_ak_	.34	.55	.08	.000	> .20
_a_dy	.22	.61	.12	1.553	.06
_a_rot	.78	.14	.08	.389	> .20
_a_ing	.13	.57	.13	.062	> .20
_a_try	.61	.01	.23	.104	> .20
_a_ce	.07	.36	.48	1.504	.06
_ _avy	.62	.18	.16	.390	> .20
_ _al	.11	.51	.29	1.104	.14
be_ _	.28	.65	.07	.016	> .20
bu_ _er	.65	.20	.10	<.250	> .20
b_e_d	.36	.39	.22	.000	> .20
b_n_na	.96	.00	.03	<.250	> .20
c_o_	.31	.54	.12	4.203	< .001

APPENDIX B (Continued)

Skeleton Words	P Food Response	P Nonfood Response	P Non-Response	K[b]	P
cre_ _	.42	.38	.04	1.725	.04
c_ _kie	.92	.00	.05	< .250	> .20
che_s_	.87	.00	.08	1.154	.12
d_s_	.21	.64	.09	2.475	.007
di_ _	.16	.79	.02	1.215	.12
di_ _er	.76	.14	.07	< .250	> .20
d_ss_rt	.95	.00	.05	< .250	> .20
_e_f	.31	.52	.15	.251	> .20
_e_ly	.32	.27	.30	.964	.17
_ _eak	.42	.50	.03	2.629	.004
fi_ _	.18	.75	.02	.844	.20
f_u_t	.78	.07	.07	< .250	> .20
h_s_	.01	.80	.16	< .250	> .20
h_n_er	.22	.50	.15	< .250	> .20
h_ng_r	.67	.30	.02	.562	> .20
_in_er	.25	.63	.03	< .250	> .20
_ic_	.06	.76	.13	< .250	> .20
_i_k	.02	.75	.14	< .250	> .20
_ic_le	.31	.39	.19	.876	.19
j_ll_	.81	.09	.05	1.535	.06

APPENDIX B (Continued)

Skeleton Words	P Food Response	P Nonfood Response	P Non-Response	K[b]	P
lun_ _	.69	.27	.03	< .250	> .20
_ _lish	.30	.20	.20	1.001	.16
m_a_	.19	.47	.25	< .250	> .20
me_ _	.43	.51	.04	1.533	.06
o_st_r	.79	.03	.14	.933	.18
_o_d	.07	.86	.04	< .250	> .20
_ou_	.09	.70	.18	2.033	.02
_ _ok	.11	.79	.07	< .250	> .20
pe_ _	.03	.93	.02	1.126	.13
pick_ _	.49	.45	.03	1.804	.04
pa_t_y	.54	.15	.22	< .250	> .20
pe_ _er	.41	.16	.17	< .250	> .20
p_ppe_	.61	.25	.18	2.038	.02
ro_s_	.61	.18	.14	2.618	.004
s_ _ce	.42	.34	.14	.789	> .20
s_e_k	.22	.51	.18	< .250	> .20
s_ _ak	.38	.17	.35	2.334	.01
s_ar_e	.03	.40	.44	< .250	> .20
s_la_	.44	.11	.36	< .250	> .20
sal_ _	.48	.34	.08	< .250	> .20

APPENDIX B (Concluded)

Skeleton Words	P Food Response	P Nonfood Response	P Non-Response	K[b]	P
_ _ster	.12	.75	.07	< .250	>.20
t_a_t	.17	.22	.50	< .250	>.20
_ut_er	.67	.26	.04	< .250	>.20
_u_ar	.31	.15	.43	2.368	.009
uppe	.73	.15	.10	< .250	>.20
ve_ _	.16	.80	.01	2.401	.008
v_ _l	.74	.11	.06	.814	>.20

[a]The data presented here constitute a restandardization of skeleton words previously standardized by Postman & Crutchfield (1952). Probabilities do not total 1.00, since nonword responses have been excluded.

[b]Test statistics for "Comparing Two Sample Proportions" (Wallis & Roberts, 1956, pp. 429-431) by means of the standardized normal variable (See Chapter II).

APPENDIX C

Standardized Skeleton Words from which Stimuli for This Study Were Selected, in Order of Decreasing Probability of Category (Food) Response

Skeleton Words	P Food Response	P Nonfood Response	Ambiguity[a]	Difficulty[b]
ki_ch_n	1.00	.00	1.00	.00
ket_l_	.99	.00	1.00	.01
p_es_rves	.97	.00	1.00	.02
le_ _uce	.96	.00	1.00	.01
b_n_na	.96	.00	1.00	.03
d_ss_rt	.95	.00	1.00	.05
grape_ _uit	.94	.00	1.00	.06
c_ _kie	.92	.00	1.00	.05
_urn_p	.88	.00	1.00	.07
aspara_u_	.82	.00	1.00	.04
pot_t_	.80	.00	1.00	.16
s_us_ge	.80	.00	1.00	.17
ca_ _age	.79	.15	.64	.04
li_bur_er	.76	.00	1.00	.20
l_m_n	.78	.07	.71	.10

APPENDIX C (Continued)

Skeleton Words	P Food Response	P Nonfood Response	Ambiguity[a]	Difficulty[b]
_a_rot	.78	.14	.64	.08
f_u_t	.78	.07	.71	.07
di_ _er	.76	.14	.62	.07
h_ _ey	.76	.01	.75	.17
v_ _l	.74	.11	.63	.06
chi_ _en	.73	.00	1.00	.11
uppe	.73	.15	.58	.10
lun_ _	.69	.27	.42	.03
squ_s_	.67	.07	.60	.16
mu_ _on	.67	.00	1.00	.25
h_ng_r	.67	.30	.37	.02
_ut_er	.67	.26	.41	.04
bu_ _er	.65	.20	.45	.10
sp_ _n	.64	.10	.54	.12
_ _avy	.62	.18	.44	.16
_a_try	.61	.01	.60	.23
nio	.57	.05	.52	.34
pa_t_y	.54	.15	.39	.22
sal_ _	.48	.34	.14	.08
s_la_	.44	.12	.33	.36

APPENDIX C (Continued)

Skeleton Words	P Food Response	P Nonfood Response	Ambiguity[a]	Difficulty[b]
s_ _ce	.42	.34	.08	.14
pe_ _er	.41	.16	.25	.17
end_v_	.37	.00	1.00	.58
b_e_d	.36	.39	.03	.22
_ak_	.34	.55	.21	.08
_e_f	.31	.52	.21	.15
be_ _	.28	.65	.37	.07
_in_er	.25	.63	.38	.03
p_ _m	.24	.67	.43	.03
_a_on	.23	.41	.18	.22
h_n_er	.22	.50	.28	.15
s_e_k	.22	.51	.29	.18
b_ _t	.19	.72	.53	.07
m_a_	.19	.47	.28	.25
fi_ _	.18	.75	.57	.02
t_a_t	.17	.22	.05	.50
br_n_h	.14	.70	.56	.12
_a_ing	.13	.57	.44	.13
_ _ster	.12	.75	.63	.07

APPENDIX C (Concluded)

Skeleton Words	P Food Response	P Nonfood Response	Ambiguity[a]	Difficulty[b]
s_ _w	.11	.62	.51	.22
s_l_	.11	.80	.69	.05
_ _ok	.11	.79	.68	.07
rip	.08	.64	.56	.18
_ra_	.07	.60	.53	.21
_in_	.07	.74	.67	.14
_o_d	.07	.86	.79	.04
_ic_	.06	.76	.71	.13
_a_e	.05	.83	.78	.10
s_ar_e	.03	.40	.37	.44
_i_k	.02	.75	.73	.14
h_s_	.01	.80	.79	.16
p_r_	.01	.79	.78	.13

[a]Difference between P Food and P Nonfood responses, except where no nonfood response is possible, in which case ambiguity is tabulated as minimal--1.00--for present purposes. The smaller the value of entries in this column, the greater the ambiguity of the stimulus item, in this special sense of the word.

[b]Probability of nonresponse. Nonword responses are excluded. Therefore, row entries do not total 1.00.

APPENDIX D

Frequency Distributions of Category Responses (CR), Noncategory Responses (NCR), and Nonresponses (NR) of One Control Group and Four Experimental Groups to Six Sets of Stimuli

Control Group Subjects ($\underline{n}$ = 40)

Frequency	Stimulus Sets								
	Set 1			Set 2			Set 3		
	CR	NCR	NR	CR	NCR	NR	CR	NCR	NR
10	0	23	0	0	0	0	0	2	0
9	0	13	0	1	1	0	0	4	0
8	0	4	0	2	2	0	1	10	0
7	0	11	0	2	0	2	0	8	0
6	0	0	0	3	2	0	0	10	1
5	0	0	0	6	11	4	0	4	1
4	0	0	0	6	9	2	0	0	4
3	0	0	0	13	3	5	6	1	5
2	0	0	4	1	7	8	11	0	5
1	0	0	13	6	4	14	12	0	13
0	40	0	23	0	1	5	10	1	11
Response Totals	0	379	21	160	156	84	60	275	65
Response Means	0.00	9.48	0.52	4.00	3.91	2.09	1.50	6.87	1.63

APPENDIX D (Continued)

Control Group Subjects ($\underline{n}$ = 40)
(Continued)

Frequency	Stimulus Sets								
	Set 4			Set 5			Set 6		
	CR	NCR	NR	CR	NCR	NR	CR	NCR	NR
10	0	6	0	0	13	0	0	0	0
9	0	11	0	0	12	0	3	0	0
8	0	12	0	0	5	0	2	0	0
7	0	4	1	0	5	0	1	4	0
6	0	4	0	0	2	0	10	1	0
5	0	1	1	0	3	3	10	7	1
4	0	0	2	0	0	2	6	13	1
3	1	2	4	0	0	5	4	8	5
2	0	0	6	0	0	5	3	2	4
1	12	0	17	0	0	12	1	4	14
0	27	0	9	40	0	13	0	1	15
Response Totals	15	324	61	0	340	60	203	151	46
Response Means	0.38	8.10	1.52	0.00	8.50	1.50	5.08	3.78	1.14

APPENDIX D (Continued)

Experimental Group:
Deduction-All Subjects ($\underline{n}$ = 50)

Frequency	Set 1 CR	Set 1 NCR	Set 1 NR	Set 2 CR	Set 2 NCR	Set 2 NR	Set 3 CR	Set 3 NCR	Set 3 NR
10	0	321	0	3	0	0	0	0	0
9	0	14	0	11	0	0	2	1	1
8	0	4	0	14	0	0	4	4	0
7	0	0	0	9	0	0	4	1	3
6	0	0	0	4	0	0	6	2	2
5	0	0	0	4	0	2	12	2	4
4	0	0	0	3	3	3	8	3	4
3	0	0	0	2	1	11	4	7	13
2	0	0	4	0	4	13	4	6	7
1	0	0	14	0	17	13	5	13	10
0	50	0	32	0	25	8	1	11	6
Response Totals	0	478	22	366	40	94	231	128	141
Response Means	0.00	9.56	0.44	7.32	0.80	1.88	4.62	2.56	2.82

APPENDIX D (Continued)

Experimental Group:
Deduction-All Subjects (n = 50)
(Continued)

Frequency	Stimulus Sets								
	Set 4			Set 5			Set 6		
	CR	NCR	NR	CR	NCR	NR	CR	NCR	NR
10	0	1	0	0	9	0	1	0	0
9	0	7	0	0	14	0	8	0	0
8	0	11	0	0	12	0	8	0	0
7	0	10	2	0	6	2	10	0	0
6	0	9	1	0	5	1	6	2	0
5	0	3	4	0	1	1	6	4	1
4	0	6	6	0	1	5	6	4	6
3	3	1	7	0	2	6	3	7	6
2	10	2	13	0	0	12	1	15	6
1	15	0	14	0	0	14	1	11	13
0	22	0	3	50	0	9	0	7	18
Response Totals	44	330	126	0	399	101	318	110	72
Response Means	0.88	6.60	2.52	0.00	7.98	2.02	6.36	2.20	1.44

APPENDIX D (Continued)

Experimental Group:
Deduction-Most Subjects ($\underline{n}$ = 50)

Frequency	Stimulus Sets								
	Set 1			Set 2			Set 3		
	CR	NCR	NR	CR	NCR	NR	CR	NCR	NR
10	0	37	0	7	0	0	1	1	0
9	0	10	0	11	0	0	1	3	0
8	0	2	0	5	0	1	3	1	0
7	0	0	0	12	0	0	6	4	2
6	0	1	0	11	0	0	7	1	2
5	0	0	0	1	1	1	5	4	6
4	0	0	1	1	2	3	4	3	6
3	0	0	0	1	1	12	5	8	10
2	0	0	2	0	4	7	10	6	6
1	0	0	10	1	16	13	5	13	10
0	50	0	37	0	26	13	3	6	8
Response Totals	0	472	18	372	40	88	208	160	132
Response Means	0.00	9.44	0.56	7.44	0.80	1.76	4.16	3.20	2.64

APPENDIX D (Continued)

Experimental Group:
Deduction-Most Subjects ($\underline{n}$ = 50)
(Continued)

Frequency	Stimulus Sets								
	Set 4			Set 5			Set 6		
	CR	NCR	NR	CR	NCR	NR	CR	NCR	NR
10	0	7	0	0	27	0	3	0	0
9	0	7	0	0	4	0	6	0	0
8	0	14	0	0	7	0	2	0	0
7	0	9	0	0	5	0	7	0	1
6	0	5	1	0	5	1	10	6	0
5	0	6	6	0	1	1	7	4	1
4	0	1	3	0	1	5	6	12	4
3	1	1	5	0	0	5	4	7	1
2	4	0	11	0	0	7	2	8	4
1	12	0	17	0	4	2	2	7	17
0	33	0	7	50	0	27	1	6	22
Response Totals	23	375	102	0	436	64	286	158	56
Response Means	0.46	7.50	2.40	0.00	8.72	1.28	5.72	3.16	1.12

APPENDIX D (Continued)

Experimental Group:
Induction-All Subjects ($\underline{n}$ = 90)

Frequency	Stimulus Sets								
	Set 1			Set 2			Set 3		
	CR	NCR	NR	CR	NCR	NR	CR	NCR	NR
10	69	0	0	6	0	0	0	1	0
9	17	0	0	8	0	0	0	2	0
8	3	0	0	9	1	1	2	13	1
7	1	0	0	13	2	1	2	11	3
6	0	0	0	17	1	2	5	14	4
5	0	0	0	14	4	1	8	9	5
4	0	0	0	11	7	11	14	14	10
3	0	0	1	7	18	11	11	6	14
2	0	0	3	3	18	25	22	9	14
1	0	0	17	0	19	18	18	3	28
0	0	90	69	2	20	20	8	8	11
Response Totals	874	0	26	538	185	177	249	433	218
Response Means	9.71	0.00	0.29	5.98	2.06	1.96	2.77	4.81	2.42

APPENDIX D (Continued)

Experimental Group:
Induction-All Subjects ($\underline{n}$ = 90)
(Continued)

Frequency	Stimulus Sets: Set 4			Set 5			Set 6		
	CR	NCR	NR	CR	NCR	NR	CR	NCR	NR
10	0	6	0	0	26	0	3	0	0
9	0	19	0	0	19	0	7	0	0
8	0	25	0	0	19	0	9	1	0
7	0	20	1	0	17	0	11	2	1
6	0	11	3	0	6	0	18	6	0
5	0	4	3	0	3	3	12	11	0
4	0	4	5	0	0	6	11	22	4
3	1	1	20	0	0	17	7	21	8
2	4	0	20	0	0	19	8	11	16
1	25	0	28	0	0	19	3	10	26
0	60	0	10	90	0	26	1	6	34
Response Totals	36	676	188	0	753	147	492	298	110
Response Means	0.40	7.51	2.09	0.00	8.37	1.63	5.47	3.31	1.22

APPENDIX D (Continued)

Experimental Group:
Induction-Most Subjects ($\underline{n}$ = 90)

Frequency	Stimulus Sets								
	Set 1			Set 2			Set 3		
	CR	NCR	NR	CR	NCR	NR	CR	NCR	NR
10	0	0	0	2	0	0	0	2	0
9	0	0	0	7	0	0	0	3	0
8	71	0	0	8	1	0	0	8	1
7	14	0	0	12	0	5	0	9	1
6	3	0	0	10	2	2	4	18	2
5	2	0	0	14	10	8	11	16	9
4	0	0	0	13	13	10	13	15	16
3	0	0	2	11	17	8	12	4	12
2	0	89	3	6	16	21	16	9	17
1	0	1	15	6	18	24	20	4	19
0	0	0	70	1	13	12	14	2	13
Response Totals	694	179	27	459	225	216	219	456	225
Response Means	7.71	1.99	0.30	5.10	2.50	2.40	2.43	5.07	2.50

APPENDIX D (Continued)

Experimental Group:
Induction-Most Subjects (n = 90)
(Continued)

Frequency	Set 4			Set 5			Set 6		
	CR	NCR	NR	CR	NCR	NR	CR	NCR	NR
10	0	11	0	0	25	0	2	0	0
9	0	21	0	0	18	0	4	0	0
8	0	20	0	0	18	1	9	0	0
7	0	20	1	0	14	0	12	2	2
6	0	8	2	0	5	5	11	8	0
5	0	5	7	0	4	4	17	16	4
4	0	4	6	0	5	5	14	14	4
3	0	1	13	0	0	14	15	18	12
2	1	0	21	0	1	18	4	18	11
1	22	0	26	0	0	18	2	9	21
0	67	0	14	90	0	25	0	5	36
Response Totals	24	691	185	0	726	174	474	297	129
Response Means	0.46	6.78	2.06	0.00	8.07	1.93	5.27	3.30	1.43

(Table column header "Stimulus Sets" spans Set 4, Set 5 and Set 6.)

APPENDIX E

Frequency Distributions of Proportions of Responses Made that were Category Responses, per Subject, to Six Sets of Stimuli, in One Control Group and Four Experimental Groups

Control Group ($\underline{n}$ = 40)

Category Responses Proportion	Stimulus Sets					
	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
1.00	0	1	1	0	0	1
.90 - .99	0	0	0	0	0	3
.80 - .89	0	4	0	0	0	3
.70 - .79	0	2	0	0	0	1
.60 - .69	0	6	0	0	0	12
.50 - .59	0	6	0	0	0	7
.40 - .49	0	8	0	0	0	7
.30 - .39	0	9	7	1	0	2
.20 - .29	0	1	11	0	0	4
.10 - .19	0	3	11	12	0	0
.00 - .09	40	0	10	27	40	0
Total of Frequencies	40	40	40	40	40	40
Total of Proportions[a]	0	20.01	7.10	1.67	0	2.275
Mean of Proportions[a]	.000	.500	.178	.042	.000	.569

[a]Totals and means of proportions were computed from ungrouped data, and will not agree exactly with totals and means computed from these grouped data.

APPENDIX E (Continued

Experimental Group:
Deduction-All Subjects ($\underline{n}$ = 50)

Category Response Proportion	Stimulus Sets					
	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
1.00	0	25	11	0	0	7
.90 - .99	0	4	1	0	0	5
.80 - .89	0	14	10	0	0	11
.70 - .79	0	2	5	0	0	11
.60 - .69	0	2	6	0	0	4
.50 - .59	0	1	5	0	0	7
.40 - .49	0	2	2	3	0	3
.30 - .39	0	0	1	4	0	1
.20 - .29	0	0	4	10	0	0
.10 - .19	0	0	4	11	0	1
.00 - .09	50	0	1	22	50	0
Total of Frequencies	50	50	50	50	50	50
Total of Proportions[a]	.00	44.84	33.17	6.22	.00	36.79
Mean of Proportions[a]	.000	.897	.663	.124	.000	.736

[a]Totals and means of proportions were computed from ungrouped data, and will not agree exactly with totals and means computed from these grouped data.

APPENDIX E (Continued)

Experimental Group:
Deduction-Most Subjects ($\underline{n}$ = 50)

Category Response Proportion	Stimulus Sets					
	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
1.00	0	26	6	0	0	5
.90 - .99	0	3	1	0	0	5
.80 - .89	0	14	9	0	0	3
.70 - .79	0	2	7	0	0	9
.60 - .69	0	3	5	0	0	9
.50 - .59	0	1	3	0	0	9
.40 - .49	0	0	3	1	0	4
.30 - .39	0	1	3	1	0	4
.20 - .29	0	0	7	3	0	1
.10 - .19	0	0	3	12	0	0
.00 - .09	50	0	3	33	50	1
Total of Frequencies	50	50	50	50	50	50
Total of Proportions[a]	.00	45.02	28.94	2.87	.00	32.33
Mean of Proportions[a]	.000	.900	.579	.057	.000	.647

[a]Totals and means of proportions were computed from ungrouped data, and will not agree exactly with totals and means computed from these grouped data.

APPENDIX E (Continued)

Experimental Groups
Induction-All Subjects ($\underline{n}$ = 90)

Category Response Proportions	Stimulus Sets					
	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
1.00	90	20	8	0	0	6
.90 - .99	0	1	0	0	0	6
.80 - .89	0	18	3	0	0	10
.70 - .79	0	18	5	0	0	11
.60 - .69	0	14	6	0	0	23
.50 - .59	0	11	10	0	0	13
.40 - .49	0	4	8	1	0	6
.30 - .39	0	0	8	0	0	6
.20 - .29	0	2	19	4	0	5
.10 - .19	0	0	15	25	0	3
.00 - .09	0	2	8	60	0	1
Total of Frequencies	90	90	90	90	90	90
Total of Proportions[a]	90.00	66.31	35.79	4.32	.00	55.48
Mean of Proportions[a]	1.00	.737	.398	.048	.000	.616

[a]Totals and means of proportions were computed from ungrouped data, and will not agree exactly with totals and means computed from these grouped data.

APPENDIX E (Concluded)

Experimental Group:
Induction-Most Subjects ($\underline{n}$ = 90)

Category Response Proportion	Stimulus Sets					
	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
1.00	0	13	2	0	0	5
.90 - .99	0	3	0	0	0	4
.80 - .89	71	16	2	0	0	11
.70 - .79	19	9	2	0	0	13
.60 - .69	0	16	11	0	0	18
.50 - .59	0	14	10	0	0	15
.40 - .49	0	5	10	0	0	10
.30 - .39	0	7	8	0	0	10
.20 - .29	0	4	14	3	0	4
.10 - .19	0	2	17	20	0	0
.00 - .09	0	1	14	67	90	0
Total of Frequencies	90	90	90	90	90	90
Total of Proportions[a]	71.48	45.02	30.17	2.93	.00	55.21
Mean of Proportions[a]	.794	.662	.335	.033	.000	.613

[a]Totals and means of proportions were computed from ungrouped data, and will not agree exactly with totals and means computed from these grouped data.