Effects of presentation mode, instructions, grade, and cognitive style on a concept formation task

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Effects of presentation mode, instructions, grade, and cognitive style on a concept formation task

by

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>METHOD</td>
<td>36</td>
</tr>
<tr>
<td>RESULTS</td>
<td>43</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>56</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>71</td>
</tr>
<tr>
<td>APPENDIX A: CONCEPT INFORMATION</td>
<td>77</td>
</tr>
<tr>
<td>APPENDIX B: INSTRUCTIONS</td>
<td>78</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>83</td>
</tr>
</tbody>
</table>
INTRODUCTION

Imagine that each and every situation encountered was entirely new, that a new and unique response was necessary for each stimulus. How would one make sense of such an environment? A person would possibly be overwhelmed, bombarded by a complex array of stimuli in a complex world. Such is not the case, for we have the ability to generalize from situation to situation, to treat each situation on the basis of previous experiences and prior interactions with the environment. This ability allows us to learn or form concepts, distinguishing humans from most other forms of life and aiding in simplifying our behavior.

A concept refers to any regularity of events or objects, real or imaginary. Pollio (1974) speaks of a concept as that which can be described in terms of a set of relevant attributes and a rule that indicates the relationship among this set of attributes. It is a group of stimuli that have characteristic(s) in common, which are then given a category label (Ellis, 1972). For example, the United States is not a concept, it is an instance of a concept. Similarly, France, England, and Borneo are not concepts but rather particular instances of the concept 'country'. This concept includes these countries as well as others, and has various characteristics which accurately and precisely define it.
To learn a concept implies that a person acquires the understanding of the regularity of objects and the relationships among these events. That is, a person learns to treat events that share certain common properties as equivalent or as members of a class. For example, when a child is learning the concept of bird, he or she learns to classify a variety of specific instances as members of a set. The label 'bird' is learned and is applied to a set of instances that have particular properties or characteristics (i.e. critical features) in common, and that are related in a particular way. Obviously, there are innumerable concepts to be learned so that new ones are being continually acquired.

The nature of concept learning

A more formal definition of concept learning was provided by Ellis (1972). "Concept learning refers to any activity in which the learner must learn to classify two or more somewhat different events or objects into a single category" (p. 138). The concept has been acquired if one can do this accurately and consistently. If, on more than one occasion, an individual can make the same response (or classification) to stimuli that share common properties, we say that concept learning has occurred. If a child has learned the label 'bird', but only applies it to Woody Woodpecker of the cartoon strip, then we cannot ascertain
that he has learned the concept of bird. We can say that
the concept has been learned only when the term is
correctly applied to varying specific instances of the
concept. A child has knowledge of the concept bird when he
calls a bluebird, robin and magpie each 'bird'.

Therefore, in order to measure true concept learning,
new instances of the concept are presented and the
appropriate classification must follow. For example, if a
child is to learn the concept round he/she is given an
orange, a specific instance of the concept, and is told
that it is a round object. The child may repeat the word
round when given an orange again, but this does not insure
that the concept is known. The child may be focusing on
some irrelevant attribute of the object such as its color,
texture, or taste, and not on its shape. In order to make
sure that he acquires the concept, one must introduce other
round objects to the child, such as a ball, a wheel, or a
balloon, and indicate that they are also round objects. To
be certain that the concept has been acquired, one must
present instances of the concept which have not previously
been seen, as well as to present non-instances of the
concept, to determine whether or not the person correctly
rejects these as examples. If the individual can both
reject non-instances and accept new instances of the
concept, the inference is that the concept has been
learned. For example, when learning the concept 'bird', a child may be confronted with winged objects such as a butterfly, mosquito, or airplane. If these are excluded as instances of the concept, one may appropriately infer that a correct understanding has been obtained.

Thus, in order that a person can both select appropriate and reject inappropriate instances of a concept relevant attributes must be identified and rules learned that combine or relate these attributes. It also requires ignoring those features of each object that are irrelevant to defining the concept.

Studying concept formation

It is possible to discover what is involved in learning concepts through experimental means. A description of the laboratory experiments conducted, the details of these situations, as well as what information is obtained, follows. A typical study involves stimuli, responses, and feedback. That is, examples and non-examples of the particular concept are shown to the subject (learner). These examples vary on a number of dimensions, such as color, number, or position - each dimension having two or more levels. That is, the dimension of color may have three values or levels: purple, orange, and chartreuse. A concept is defined in terms of these dimensions, some being relevant to its
definition, others being irrelevant. For example, a concept may be 'two purple objects'. Number and color would define a positive instance of this concept, with size and shape being irrelevant dimensions. The task of the subject is to label a series of items with a single concept name, or to say 'yes, it is an instance' or 'no, it is not an instance' as each example is presented. Feedback concerning correctness or incorrectness of the response is given by the experimenter, until the subject can accurately name the concept or correctly classify numerous successive items as being examples or non-examples of the concept.

Psychologists utilize two primary methods of determining and describing concept formation behavior (Bourne, Ekstrand, Dominowski, 1971; Ellis, 1972; Pollio, 1974). These two differ mainly in who determines the sequence in which instances of the concept are encountered during the experiment, the experimenter or the subject himself. Each experimental procedure or paradigm is "a set of loose rules for the arrangement of events in an experiment" (Bourne et al., 1971). Thus, depending upon the study, these rules will vary. The method of presentation will be modified to coincide with the purpose or goal of the study.

A common experimental procedure involves the experimenter's presenting the stimuli one at a time. The
order of presentation in this reception paradigm may be random or some predetermined arrangement. The subject classifies each object presented as an example of one of a set of concepts. If only one concept is involved or being learned, each stimulus is classified as either a positive or a negative instance of the concept. This response on the part of the subject is immediately followed by informative feedback. If the classification were incorrect, the correct response could be given. Or, this informative feedback can be a simple 'yes' or 'no' concerning accuracy or the correct response itself. Usually, one stimulus is presented per trial, followed by a response and then feedback. This procedure continues until the subject can categorize stimuli without making errors or until he/she can give an hypothesis stating the concept. A criterion measure that is commonly used concerning performance is the number of trials it takes before the subject stops making errors (Bourne et al., 1971).

Two variations on this reception paradigm are found in the literature. In one, stimuli are presented to the subject individually, one at a time. This is known as successive stimulus presentation. Before a new stimulus is shown, the preceding one is taken from the subject's view. Since such a task is demanding of one's memory, an alternative to this method, simultaneous presentation, is
often used. In this case, all of the stimuli are laid out in an array for the subject to view. For each trial, the experimenter indicates which stimulus he wants the subject to categorize. Cahill and Hovland (1960) found this procedure to facilitate concept learning, reducing the number of trials to solution. These two possible modes of presentation in a reception procedure may appear to be rather contrived situations if one considers the normal manner in which concepts are learned. An individual is typically not passive in acquiring information about concepts, nor are instances presented one at a time by nature. Wason (1960, 1968) found that an individual actively seeks further information to confirm or to reject hypotheses. It is common for a subject to search his/her environment for appropriate examples so as to substantiate or modify the concepts he/she already has formed and which are in his/her repertoire. Such an active search was focused upon and employed initially in studies conducted by Bruner, Goodnow, and Austin (1956). The method they used allowed the subjects free choice in determining what information was needed in order to be assured that they had learned the concept. Such a procedure is appropriately labeled the selection paradigm, implying activity on the part of each subject. The subject is free from constraints placed upon him/her by the experimenter as in the reception
paradigm. The set of stimuli is placed before the learner from the onset of the experiment. Typically the experimenter designates one exemplar as a positive instance, and asks for an hypothesis. For each succeeding trial, the subject chooses a stimulus on which he/she wants feedback, and the experimenter informs him/her whether it is a positive or negative instance of the concept. Again, this routine continues until the subject can consistently name stimuli correctly as examples of the concept. Therefore, the selection procedure allows an individual to choose concept instances at his/her own discretion whereas subjects in a reception paradigm are at the 'mercy' of the experimenter for task information.

Strategies employed in conceptual behavior

One of the primary assumptions psychologists make is that human behavior is not random, but rather follows laws or rules which can be discovered and delineated. Behavior involved in concept formation is no exception. Subjects solving conceptual problems display behavior in which organization and structure can be found (Bourne et al., 1971) in spite of the complexity and demands of the task. Instead of randomness characterizing an individual's approaches to the problem, one finds that hypotheses and 'strategies' are major guides towards successful performance. These aspects of the problem-solver's
behavior can be measured and then related to the task requirements and to conditions of the subject as well.

First of all, one must define what is meant by the term 'strategy', as used in connection with concept learning. Pollio (1974) refers to systematic behavior that follows some sort of plan as being a strategy. An individual is said to follow a strategy if his/her responses have an organization that is sequential and leads to a solution. The original, pioneering research on strategies used by subjects was by Bruner, Goodnow, and Austin (1956). A major outcome of their work was that they were able to demonstrate that conceptual problem solving behavior is highly organized as well as intentional (Bourne et al., 1971). Thus, an individual approaches a problem solving situation with the opportunity to systematically and intentionally determine the solution.

The organized plans of attack and strategies employed in concept formation are not idiosyncratic to the particular individual but have been found to be categorizable. Although Bruner et al. (1956) could not determine the strategic approaches of all of their subjects, after considerable effort and scrutiny of the data, they concluded that most strategies could be considered one of two basic types, focusing or scanning. Both of these have two variations, yielding four categories
of strategies.

**Focusing strategies**

One of these general categories of strategies was termed 'focusing'. A positive instance of the concept is chosen as a focus. In order to determine the relevant attributes of the concept, the subject uses an elimination process which compares each instance as it is presented, with the chosen focus. An illustration of one type of focusing behavior, conservative focusing, may help to clarify this strategy. Consider a problem in which the selection paradigm is employed. The subject is presented an array of cards, some of which are positive incidents of the concept, some of which are not. One card is designated as an example of the concept. For example, the experimenter has designated two (2), small (S), green (G), triangles (Δ) as the exemplar. If a subject uses a focusing approach, he will accept this stimulus and all of its attributes as a focal point and as possibly relevant to the identification of the concept. Therefore, his first hypothesis as to the correct concept is \(2SG\Delta\). A second pattern is then selected, say \(2SG\bigcirc\). If the experimenter acknowledges that this, too, is a positive instance, the subject compares this with the focal point \((2SG\Delta)\). This procedure reveals that what differs in these two instances is form. Since both patterns are positive
instances, form must not be relevant to concept identification. Thus, a subject would have as his/her next hypothesis 2SG. A third pattern is chosen and is 2SP (purple). The subject is told that this is not an example of the concept, so he compares this choice with the focal instance (2SGΔ) to see what dimension is different. Upon comparison, the subject can determine that green must be a relevant attribute (the dimension of color) since green patterns are positive instances, but not purple ones. Therefore, no change in the hypothesis (2SG) is required. Such a pattern continues, the subject choosing an example, comparing it to the focal instance, and revising the hypothesis if necessary, until the subject has all of the needed information to determine the concept accurately.

This illustrates how the subject's systematic behavior is determined by the pattern of stimulus choices made and the hypotheses formed. When given a positive instance initially, he uses this as a focus and develops a hypothesis based upon all of the characteristics of this pattern. A series of decisions is made which either confirms or eliminates an aspect of the stimulus as relevant to the concept. Each 'updated' stimulus choice varies on only one dimension at a time from the focus. This approach, labeled conservative focusing (Bruner et al., 1956), permits attributes to be checked individually
for relevance and insures that each trial will provide some information leading to the concept solution.

Subjects also utilize a form of focusing that is more reckless, less restricted. Pollio (1974) points out that if cards are randomly presented, conservative focusing may not be possible, and focus gambling could be employed. The first card presented again serves as the focus, but instead of modifying only one attribute at a time, the subject changes more than one single attribute with each choice of cards.

Recall once again, the example in which the initial focus is the stimulus 2SGA. The second pattern chosen by the subject may be 2LGO, a stimulus which differs on two attributes (size and form), yet which is designated as a positive instance. Thus, when compared with the focus, the subject learns that size and form are irrelevant to the concept and thus comes to the solution more rapidly. Being less conservative, in this case, has paid-off and the number of trials needed to achieve a solution is reduced. Pollio (1974) speaks of this as an advantage since it is possible for an individual to jump to a correct conclusion with reduced time and trouble. However, greater risks may also characterize such an approach. If the second stimulus that was chosen as an example (2LGO) were a negative instance, the subject would compare this to the focus and
notice that size (small), form (triangle), or both could be relevant dimensions. This would require more selections to determine which is the case, changing one attribute at a time and thus increasing the total number of trials needed to determine the concept. This strategy, potentially riskier, is appropriately termed focus gambling.

**Scanning strategies**

The second basic classification of concept-solving strategies resembles what Ellis (1972) refers to as scanning, a hypothesis selection and testing approach. Theories revolving around scanning behavior emphasize the activity of the learner in selecting, testing, and rejecting or accepting potential solutions. Bruner et al. (1956) observed that many individuals do not use a focal instance by which they determine relevant and irrelevant attributes of the stimuli. Instead, many individuals apparently form a hypothesis as to what they think the solution is and categorize the stimuli with respect to this hypothesis. Stimuli are chosen to test the generated hypotheses. When a stimulus is picked as though it were a positive instance and the subject is told that it is not correct, the hypothesis is then revised. This general approach is labeled scanning. Again, two variations of this strategy have been delineated. If a subject develops a specific hypothesis on the basis of the initial card
chosen and then attempts to confirm or disconfirm the hypothesis being considered by gathering evidence, he/she is using a successive scanning approach. For example, a subject in the previous example has developed the hypothesis that 'two circles' is the appropriate concept. The next stimuli chosen are picked in accordance with this hypothesis, until a negative instance is encountered, at which time the hypothesis is modified. Such a method has the advantage of lessening memory strain since only the present hypothesis must be remembered at any particular moment. This is in contrast to what is termed simultaneous scanning. In this approach, an individual is thought to consider all of the possible hypotheses at the same time. Each card choice is an attempt to eliminate those hypotheses which are incorrect. Such a strategy would tax one's memory and thus be a difficult undertaking (Pollio, 1974).

Scanning is not as economical or efficient as focusing strategies (Laughlin and Jordan, 1967; Laughlin, 1975). It is not as systematic an approach to determining the relevant concept attributes. Often times, successive scanning produces errors, since certain aspects of hypotheses that were disconfirmed in prior choices may be included in the concept currently being considered. Therefore, a subject may reconsider dimensions which have
already been rejected. One's memory of all the previously tested hypotheses may fail, leading to redundant selection and testing. In the simultaneous scanning situation, it is also necessary that an individual keep in mind those hypotheses that are still tenable. It is not difficult to see that an individual's memory may be taxed when one considers the limitations that characterize a human mind.

Focusing approaches allow a type of bookkeeping system. On each trial the subject has to recall only one stimulus which represents a certain group of attributes. This card is revised continuously, based upon successes or failures on previous trials and on what is left to be tested.

Focusing and scanning strategies have been delineated as a result of studies employing selection paradigms. There is a question as to whether or not similar strategies are used in situations in which the subject does not have a free choice as to what the next stimulus will be (reception paradigms). In these situations, the experimenter presents the instances in a predetermined order. Levine (1966) has described a variation of focusing which has been observed in the concept formation behavior of individuals having no control over order of presentation. The first positive instance presented by the experimenter is used as a 'focus'. A working hypothesis is created on the basis of this instance's attributes. Each successively shown
stimulus is compared with this focus and a subject eventually determines the concept. Such a strategy is called wholist or wholist focusing. This strategy is difficult to follow since the presentation of stimuli may be random, not following any particular order. Or, this order may not be what the subject would prefer to test. However, an attempt is made to create an hypothesis which encompasses those attributes which may still be relevant to the concept, utilizing a focus as in a selection paradigm.

The use of scanning strategies also has been suggested (Levine, 1966) in reception paradigms. Here, based upon some attribute of the first positive instance given, subjects develop an hypothesis and ignore other potential hypotheses. This is termed a partist strategy. In either case, it is difficult to determine if a strategy is used consistently, since the experimenter has control of the situation. Such a circumstance does not allow for a crucial component of concept formation, the subject's own selection of stimuli from the domain of possibilities. Therefore, it is a challenge to the experimenter to make statements concerning strategies the subject uses, if any.

Factors that influence concept attainment

As a result of these conceptual strategies, an individual eventually discovers the concept under consideration. Such concept formation varies in difficulty
of attainment. The ease and rapidity by which a particular concept is learned is greatly affected by aspects of the situation in which the instances are presented, as well as characteristics of the concept itself. These can be included under the topic of task variables.

One condition which may affect the speed of concept attainment is the presentation of positive or negative instances, or both. This issue considers the nature of the instances presented (Ellis, 1972). Typically, when learning about a concept, both positive and negative instances are dealt with. It is thought that since we are more likely to encounter positive instances, we should learn more quickly from positive examples of the concept. Early studies (Smoke, 1933) supported this view that there is an advantage in presenting positive instances, while making less use of negative instances. Although negative instances were considered to have some merit, these studies indicated that their primary advantage was for providing a background or context for evaluating the positive instances. It was pointed out by Hovland (1952) that the negative instances usually do not contain much information as to the nature of the concept. Subjects may learn less from negative examples because there is less to be learned from them. Hovland and Weiss (1953) investigated this idea by equating negative and positive instances with respect to
their information load. They demonstrated that negative instances do provide enough information to identify concepts, but also that positive instances are more efficiently used by individuals. A direct relationship between overall efficiency of performance and the percentage of positive examples also lends support to the idea that positive instances are more beneficial to rapid concept formation (Schvaneveldt, 1966).

Such results are understandable when one considers how we typically learn concepts. Rarely are they formed in everyday life through negative instances alone. Knowing that something is 'not-X' only helps us if there is a small number of hypotheses possible. But, in general, this does not help rule out other possible concepts (Pollio, 1974).

Bruner, Goodnow, and Austin (1956) suggested that the majority of educational processes, both natural and formal, are built around examples of what a concept 'is', rather than what it 'is not'. When teaching a young child what a tree is, an individual would point out to him positive examples, such as oaks, maples and junipers, not negative exemplars such as traffic lights, automobiles, and dogs. Since real-life situations are like this, it is not astonishing that positive instances presented during concept formation experiments are easier to learn from than are negative examples. Freiberg and Tulving (1961), however,
demonstrated that with practice or with training at using negative instances, only slight differences in speed and efficiency of concept formation were noticed between this group and those given only positive instances. It is as yet difficult conclusively to state that with practice humans will be as able to utilize negative instances as positive instances. Other results (Wason, 1961a, 1961b) found subjects almost never try to negate an hypothesis, but prefer to confirm it, even after extended practice with negative instances. For whatever reason, subjects prefer positive instances when forming concepts.

A second task characteristic to consider in concept formation problems is the saliency or distinctiveness of the dimensions since some properties of the stimuli are more obvious than others. Dimensional saliency is measured by the frequency with which particular dimensions are chosen as the basis for categorization of stimuli. Such a factor was found to influence learning (Zelniker, Oppenheimer, Renan, 1975). Concept identification was achieved more rapidly when the preferred (most salient) dimension was necessary, or relevant, to solve the concept than when it was irrelevant (Johnson, Warner, and Silleroy, 1971; Odom and Mumbauer, 1972). This occurred especially with children as subjects. Odom and Mumbauer (1972) found that although the dimensions which are most and least
salient (i.e. the hierarchy of dimensional saliency) may change with development, the relative salience of a dimension is negatively associated with response time and number of errors on identity tasks. Younger children tend to learn color concepts more readily than form concepts (Bourne and Restle, 1959), with number and position being less salient than form or color (Zelniker et al., 1975). At this age, if number or position were relevant to determination of the concept, speed and accuracy would be negatively affected. Therefore, acquisition of a concept will be influenced by the saliency (for that subject) of the relevant dimensions.

When defining any concept, certain dimensions are relevant to its description while others are not. The number of these relevant and/or irrelevant dimensions obviously will influence the speed and difficulty of concept acquisition. One question dealing with this aspect has concerned how the efficiency of concept attainment is affected when the number of relevant and irrelevant dimensions varies or is high. It has been quite well established that performance (e.g. number of trials to solution) is linearly related to the complexity of the concept, the number of relevant dimensions (Archer, Bourne, & Brown, 1955; Bulgarella and Archer, 1962; Schvaneveldt, 1966; Frederick and Klausmeier, 1968). Time and trials to
solution as well as errors increase when number of irrelevant dimensions increases (Bulgarella and Archer, 1962). These results have been found over a wide range of complexity (concepts with one or more than one dimension) and types of conceptual principles - conjunctive, disjunctive, biconditional (Haygood and Stevenson, 1967; Kepros and Bourne, 1966). Frederick and Klausmeier (1968) demonstrated that when the total number of dimensions is held constant and the proportion of relevant and irrelevant dimensions is varied, the difficulty becomes a function of the number of relevant dimensions, not the number of irrelevant dimensions. For example, a concept that has three relevant and two irrelevant dimensions will be more difficult to learn than one with two relevant and three irrelevant dimensions. To solve for a concept, the individual must test the variable dimensions for their relevance. Testing for each dimension will usually take a certain fixed number of trials. With an increase in the number of relevant attributes to contend with, there is more information to reduce or condense, increasing the task difficulty.

A final aspect of the task which must be considered as potentially affecting the ease of concept formation is the method of stimulus presentation. The two most commonly used procedures - reception and selection - were previously
described. These two paradigms have been compared with respect to ease of concept formation but results depend upon a variety of factors, thus the data are not clear. Age differences appear in the literature. Hunt (1965) found that adults perform better (i.e. quicker concept attainment) when given their own selection of stimuli as opposed to experimenter-imposed stimulus presentation. In contrast, reception procedures appeared more efficient for young children than a selection strategy (Huttenlocher, 1962). Results are not definitive, since other studies (Murray and Gregg, 1969; Laughlin, 1972; Smalley, 1974) have found superior performance using a reception paradigm (and adult subjects). However, this may occur when the complexity of the concept is increased. Flaherty and Flaherty (1974) and Laughlin (1975) found that performance seems to be relatively better using selection paradigms when learning conjunctive concepts (e.g. every flower which is yellow and has four petals is an example). On more difficult concepts (disjunctive or conditional), the reception paradigm appears to aid performance more so than selection procedures. (An example of a conditional concept is: 'If a flower is yellow, then it must have four petals.' 'Every flower which is yellow or has four petals or both', is an example of a disjunctive concept).
Selection paradigms increase the demands on attention, yet for adults (in conjunctive concept situations) produce more rapid concept attainment than reception paradigms. Those individuals with characteristically longer attention spans and more highly developed strategies may readily adapt to a selection procedure and be successful at it. Younger children and those who employ less mature strategies would not perform as well under these demanding conditions. Thus, they should benefit from a paradigm which utilizes a reception technique for concept formation. As the task becomes increasingly more difficult (disjunctive or conditional rules), however, it may be necessary for the experimenter to present the stimulus instances since the memory load would be too great - for old and young subjects alike.

**Individual learner characteristics - slow/accurate-fast/inaccurate**

The factors just mentioned which influence concept formation were task or situation variables that are external to the subject himself/herself. The ease or difficulty of concept acquisition is not solely a function of these characteristics. Rather, attributes of the person learning the concepts also will partially determine how quickly and efficiently they are acquired and the strategies used in the process. Such things as attitudes,
motivation, abilities, and learning 'styles' are classified as learner variables, having relevance to concept formation. People differ in their overall efficiency when solving problems or learning something new. Any experiment will have a wide range of scores revealing differing levels of performance on the tasks involved. What characteristics the individual possesses which produce these differences and the various styles of approach to the problems are not easily discovered. However, individual differences consistently occur and do have relevance to concept formation studies, thus are worth the emphasis.

A term that has been coined to refer to persistent individual differences in modes of behavior and thought is cognitive style. The various patterns of perceiving, memorizing, organizing, and utilizing the stimuli presented are a few of the aspects of an individual's cognitive style. In any educational or learning situation, these dispositions may partially determine the extent of learning, the ease of concept acquisition, possibly the effectiveness of the instructional method. Bourne et al. (1971) refer to cognitive styles as ways to achieve intellectual goals. These styles are general enough to characterize much of an individual's activity and can distinguish one individual from another individual who is attempting to achieve the same goal.
One disposition which has implications for learning is the individual's tendency to be either slow and accurate or fast and inaccurate. An individual may reflect on his/her cognitive products and their quality prior to making a response or judgment, or he may answer impulsively, accepting an early response (Kagan, 1965a). Research dealing with this cognitive dimension has focused on error rate and on the time it takes to make a response (response latency) in situations that involve response uncertainty. The task most frequently employed to measure this style is the Matching Familiar Figures (MFF) test. This task requires that the individual choose the one figure from among six alternatives that he/she thinks is identical to the standard. Since these choices are all exceedingly similar, the difficulty of the task is rather high. Measures are made of the time an individual takes to make his or her first response as well as the total number of errors on each trial.

In numerous studies on such visual matching tasks, a negative correlation, on the average approximately -.55, has been found between response time and the number of errors made (Kagan and Messer, 1975; Ault, Mitchell, & Hartmann, 1976; Sola and Phye, 1976). Impulsive individuals (fast/inaccurate) are those who show short response latencies prior to responding while making
numerous mistakes overall. It is possible that they act on the first hypothesis generated without considering its 'goodness' or inappropriateness. Those who display the opposite tendencies on such tasks are considered slow/accurates (reflective). They take more time to analyze the situation as well as make less frequent errors in responding. In any sample, those scoring both below the sample median on response latency and above the sample median on errors are deemed fast/inaccurates, those individuals scoring above this median on response latency as well as below the median on errors are defined as slow/accurates. Consequently, this concept of cognitive tempo, although consistent within the individual, is relative in nature since the latency and error medians depend upon each sample involved.

**Cognitive approaches of slow/accurates and fast/inaccurates**

Data have shown that slow/accurate individuals are predisposed to search for subelements within a stimulus situation and to split up the total situation analytically (Lee, Kagan, and Rabson, 1963). These findings occur when the subject is asked to look for similarities between objects that are within larger stimulus contexts. Kagan, Moss, and Sigel (1963) found that such kinds of analytic responses were associated with longer response times. This
led to the prediction that those who were analytic towards the stimuli may be less impulsive in other test situations as well. Kagan (1965b) studied the effect of analytic attitudes on reading errors and found that response time and the number of head-eye fixations (the number of times the head and eyes moved up to study the standard before the first hypothesis was elicited) correlated highly. This suggested that the alternative answers were being actively considered during the interval prior to the emission of the first response.

A few studies have probed further into the observing behavior and eye movements of fast/inaccurates and slow/accurates in order to delineate the differences in cognitive approaches on a MFF task (Kagan, Pearson, and Welch, 1966b; Sigelman, 1969; Drake, 1970). Generally, fast/inaccurates were found to ignore more alternatives and to look more globally at the standard. They apparently were not critical when evaluating the quality of their answers. Fast/inaccurate college subjects were found by Drake (1970) to observe the standard for a greater proportion of the time, and to look less precisely at the choices. Slow/accurates, however, were shown to frequently recheck all the alternatives during the course of the task. The proportion of the time devoted to the standard was less for slow/accurates than for the fast/inaccurates. The
reason suggested for this difference was that the slow/accurates tended to analytically study the alternatives and then compare them with the standard. These results would suggest that by modifying only response time, performance would not also necessarily improve but that their cognitive approaches must be considered.

Studies (Kagan, Pearson, and Welch, 1966a; Reali and Hall, 1970; Yando and Kagan, 1968) have shown that the error rate on MFF items is not lowered by training fast/inaccurates in lengthening their response time alone. However, training procedures that teach fast/inaccurate children information processing skills that are more efficient than those they originally use have been generally successful in improving performance (Ridberg, Parke, and Hetherington, 1971; Egeland, 1974). For example, Egeland (1974) designed a training procedure that would teach fast/inaccurate children to break stimuli down into component parts, to look at the segments of each alternative, and then to check the standard to determine if the segments correctly match the standard. An increase in response time and decrease in errors on the MFF was found immediately after training, as well as on post-tests given two months later. Failures of studies modifying only response time and successes of those focusing on the cognitive approaches, indicates that emphases in research
might well be placed on the cognitive strategies used by individuals as well as on attentional characteristics. There is some information that suggests few differences between slow/accurates and fast/inaccurates with regards to basic perceptual processing (Ault, Crawford, and Jeffrey, 1972; Odom and Mumbauer, 1972). Rather, the differences may be due to attention-sustaining deficiencies (Weiner, 1975). Zelniker, Jeffrey, Ault, and Parsons (1972) compared slow/accurates and fast/inaccurates on the MFF and the DFF (a task on which the subjects find the figure that is different than the standard). They found that with a modification of the task, the scanning strategies of the fast/inaccurates were modified. These modifications were maintained on a MFF task given later. Their suggestion was that a change in motivation in the fast/inaccurate subjects occurred, increasing attention and thus improving task performance.

Weiner and Berzonsky (1975) demonstrated that slow/accurate sixth graders showed less incidental and more central learning than fast/inaccurates. Central learning refers to the ability to pay attention to the principal aspects of the task at hand. This involves selective attention. The individual concentrates more exclusively on (thus recalls) the primary task features. In the case of incidental learning, a greater amount of irrelevant
features and details are attended to and remembered, indicating nonselectivity. With age, a child becomes more capable of directing attention to the central aspects of a task, whereas the amount of incidental learning does not change (Hagen and Hale, 1973). This suggests that sixth grade slow/accurates were beginning to use selection strategies that fast/inaccurates did not. Fast/inaccurates may have difficulty attending selectively because of problems in distinguishing relevant from irrelevant cues, thus inflating their incidental learning scores and lowering central learning. Such attentional difficulties may lead them to try to remember all the cues, since they are not as efficient in determining which are the important cues, thereby hampering learning.

Aside from attentional aspects, recent studies have dealt with the question of how cognitive strategies of fast/inaccurates and slow/accurates differ and what repercussions a particular strategy may have for the individual. Results of a study by Bush and Dweck (1975) suggested that slow/accurates could not only respond cautiously when the situation required, but could adapt to the demands of the task. Utilizing three tests that stressed quick decision-making, they found that slow/accurates (as classified on the MFF) were no slower than fast/inaccurates on these tasks. They were oftentimes
faster and their error rates were lower. That is, slow/accurates were able to respond quickly and accurately when the need arose. They demonstrated a flexible approach by utilizing strategies that apparently took into account current task requirements. Such results suggest flexibility of strategies on the part of the slow/accurate (reflective) individual which would aid this person on a variety of learning tasks, yielding greater efficiency.

**Exploration of problem-solving behavior of fast/inaccurate and slow/accurate individuals**

Several techniques have been recently developed and used which allow for the investigation of problem-solving strategies. These procedures present the subject a problem which has a finite number of solutions. The task is to discover the correct solution by gathering information which eliminates alternatives that are incorrect. McKinney (1973) presented fast/inaccurate and slow/accurate second grade subjects a matrix solution task in order to assess their problem solving strategies. They were shown a matrix of flowers which varied on three dimensions. The correct flower was to be discovered by asking questions that could be answered yes or no. The findings indicated that more information was obtained from the questions of slow/accurate subjects than from those questions asked by fast/inaccurates. The slow/accurates also used a focusing
strategy more frequently while fast/inaccurates tended to process information in a trial-and-error manner. In other studies (Ault, et al., 1972; Denney, 1973), twenty-question games were used and again slow/accurate children asked questions which provided more relevant information than did fast/inaccurates. Also, the strategic approaches utilized by the younger slow/accurates were comparable to those used by older fast/inaccurate children. Neussle (1972) showed that slow/accurates were more proficient in concept formation tasks, demonstrating that there was a similarity in the focusing behavior of slow/accurates who were in the fifth grade and fast/inaccurates who were in the ninth grade. It appears that the level of development of strategies for problem-solving differs in these groups of children. Recently, McKinney (1975) presented seven, nine, and eleven year old fast/inaccurates and slow/accurates a series of five problem solving tasks, increasing in difficulty. Results again supported the suggestion that cognitive tempo influences strategic approaches and therefore efficiency. The greatest impact upon the problem-solving behavior occurred in the seven and eleven year olds, and less so with the nine year olds. Slow/accurate children at the seven year old level displayed a higher incidence of focusing behavior than fast/inaccurates on three of the five tasks. They also
were more systematic when testing hypotheses. Fast/inaccurate seven year olds were not likely to form abstract hypotheses, but instead, used a trial-and-error strategy to process task information. Of further interest was the finding that slow/accurate subjects showed continued improvement between nine and eleven years of age on a pattern matching task and pictures problem. However, fast/inaccurates showed minimal gains, if any, in their problem-solving efficiency on these tasks. Nine-year-old children were very similar, regardless of the cognitive tempos, but by eleven years of age, slow/accurates displayed a significant increase in focusing behavior on these tasks, while fast/inaccurate children continued to utilize a mixed strategies approach.

Goals of this study

This review of the literature suggests that slow/accurates and fast/inaccurates (as measured by the MFF) differ in the use of sophisticated, time-consuming strategies, potentially affecting the efficiency of concept formation. It was hypothesized that the optimal strategy is adopted earlier by slow/accurate individuals and that they use a focusing approach in a great number of problem situations, thus solving them in fewer trials than do fast/inaccurates. The goal of this study was to obtain information concerning the efficiency of the strategic
approaches of slow/accurates and fast/inaccurates on a concept formation task. By varying the age level (testing fourth and sixth graders) age differences in performance were analyzed and levels of development compared. If slow/accurates and fast/inaccurates do differ in the maturity of strategy usage, such a developmental study would provide indications of the differential efficiency of their particular strategy at varying ages. It was predicted that slow/accurate fourth graders would perform similar to sixth graders of a fast/inaccurate style.

Hypotheses concerning differential criterion performance under selection and reception paradigms were developed. A selection condition, in which an individual is left to his or her own devices or strategies may allow for superior performance on the part of older subjects and/or slow/accurate subjects. It is suggested that these individuals have more highly developed, therefore efficient, strategies. If it is the case that fast/inaccurate individuals do not employ well-developed strategies, a reception condition presenting concept instances in an optimal manner may be more beneficial to their performance than a selection condition. This would also be expected if fast/inaccurates have attentional deficiencies. A concept formation task demanding more from one's attention (i.e. a selection paradigm) should produce
superior performance on the part of those who *can* direct their attention to the task at hand. Additionally, by instructing subjects to utilize a focusing approach, it was predicted that deficiencies in strategy usage would be corrected (if these instructions are heeded). It was hypothesized that those subjects given such instructions would perform better on the concept formation task under consideration. It was suggested that subjects not as mature in their strategies would benefit more from instructions than those already using focusing or mixed approaches.

Assumptions were that if this dimension of cognitive style were a generalized characteristic of an individual, the latency of response on the MFF task should be related to latencies on an attention task. Also, if deficiencies in attention deployment are characteristic of fast/inaccurate individuals (as measured by the MFF), such an attention task should reflect these possible differences. Thus, it was hypothesized that there should be a correlation between a measure of latency on an attention task and latency as measured by the MFF. Differences in average latency for fast/inaccurates and slow/accurates were expected as well.
METHOD

Subjects

Eighty-two subjects were selected from the fourth and sixth grade classes at the Gilbert, Iowa, Community School. The mean ages for the fourth and sixth grade classes were 10.6 and 12.6 years, respectively. There were 20 females and 20 males in the fourth grade sample and 25 females and 17 males in the sixth grade sample. Fourth and sixth graders were randomly drawn from the classroom and randomly assigned to the experimental groups. All were administered the Matching Familiar Figures (MFF) task and the Attention Diagnostic Method (ADM), as well as a concept formation task. Initially, all subjects were individually given the MFF and the ADM. Within two weeks, they were presented with a concept formation task under one of four conditions: (1) Reception-No instructions; (2) Reception-Instructions; (3) Selection-No instructions; and (4) Selection-Instructions. Approximately twenty subjects were in each condition - ten from each grade. The dependent measure obtained from this task was the average number of trials to reach the criterion of four consecutive correct responses.

Materials

The Matching Familiar Figures (MFF) test, as developed by Kagan (1963), was used to obtain a measure of each
subject's conceptual tempo. As a means by which attentional aspects of an individual's behavior can be assessed, as well as a construct validation device, the Attention Diagnostic Method (ADM) was administered. This technique, developed by J. R. Block (1975) was used to identify those individuals who show failures of attention. When performing this task, the subject sat facing a display board that had the numbers 10 to 36 painted upon it, arranged in a random order. Each number was painted one of five bright colors - red, yellow, black, blue, or green. The subject was to locate the digits in numerical order and name both the number and its color. For example, the subject would say "Ten-green, eleven-blue, twelve-white" and so on. The time required to locate each number was recorded on a strip recorder. Thus, as in the MFF, a measure of latency was obtained for each response. It was advantageous to utilize this instrument since it gives an indication of attention over a period of time - twenty-five data points are recorded. ADM latency was compared with performance on the MFF - a validation of this reflection-impulsivity task. It was expected that if reflection-impulsivity (slow/accurate vs. fast/inaccurate behavior) is a general characteristic of the individual's style, similar performance should be found on this task, also an attention-sustaining task.
The materials for the concept formation task were 3 x 2 inch cards containing figures which differed in four respects: 1) in shape, 2) in color, 3) in number, and 4) in size. The shapes involved were squares, circles, and crosses. There were one, two, or three figures on each card, varying in color - blue, green, or red. Sizes of these objects were small (1/2"), medium (1"), and large (1 1/2"). These concept cards were arranged in an orderly fashion on a large board. This stimulus board was in full view of each subject throughout the experiment. Concepts are listed in Appendix A.

Procedure

A counter-balanced design was employed. In the first session one-half of the students were administered the Matching Familiar Figures test for reflection-impulsivity prior to performing the ADM. The typical procedures and instructions for administration of this test were used. Following the MFF administration these subjects were tested on the Attention Diagnostic Method (ADM), according to its usual administration procedures. The remainder of the subjects were initially given the ADM followed by the MFF.

During the second session, presentation of the concept formation task occurred. The task given was based upon that used by Bruner, Goodnow, and Austin in their initial (1956) work on concept attainment. Each subject was
presented a large board containing the array of 81 cards. A geometric figure was contained on each card. Figures were arranged in an orderly manner with all cards of the same shape or color together, as well as the same number or size. This orderliness was to eliminate the difficulty a subject may have had when choosing one card for testing.

Each subject was told that each figure was a combination of four attributes. They were informed that each attribute had three levels but that only one level of each could be on a card. The subject was told that the experimenter was thinking of a particular concept and that his or her task was to determine what the concept was. Subjects also were instructed that each concept was a combination of two of the attributes, a conjunctive concept, and that two attributes were irrelevant to its definition. The concept may have been a combination of one level of color (red) and one level of number (2). Thus, the concept would have been 'two red objects' with size and shape as non-determiners. Initially, the subject was shown a particular card that exemplified the concept the experimenter had in mind. This was considered a positive instance of the concept.

In addition to a thorough description of the task, subjects also received an explanation of the meaning of a concept. Instructions were as follows: "In this task you
will have to figure out what concept I am thinking of. A concept is how you can group things in ways that they are the same." They were then given examples of concepts, such as 'dog', as well as examples such as were included on the task (all cards with blue crosses, for example). To ascertain that they understood what a concept was, they were given a number of concept names and told to point to examples of these on the array of cards. Instructions can be found in Appendix B.

Under the **selection condition**, subjects were informed that their task was to point to cards, one at a time, which were considered by them to be examples of the concept. Following each choice, the experimenter told the subject whether the card chosen was a positive or a negative example of the concept. For the **reception condition**, the experimenter first pointed to an example of the concept, indicating that it was a positive instance. The experimenter then continued to point to cards and the subject's task was to indicate whether or not he or she considered it to be an example of the concept. Under this situation the experimenter pointed to cards in an optimal manner - using essentially a conservative focusing approach. Each card pointed to varied from the first card (focus) on only one attribute. Subjects were given an indication of the new focus card each time it was changed.
In the instructions condition, subjects were informed of the optimal manner by which one could solve the problem— that is, a focusing approach. Those receiving instructions while under the selection condition were told to use the first positive example pointed to by the experimenter as a focus. They were told how to vary each of the following card choices one attribute at a time from this focus card, in order to determine the relevant attributes. If subjects were in the reception condition, and receiving instructions, they were told that the experimenter would be varying one attribute at a time from the focus card, and that it would be most efficient to note the attribute that was varied and whether or not this attribute was relevant to defining the concept. Practice and examples of a focusing strategy were given to each subject under both instruction conditions.

Each subject was individually tested with the array of cards in full view at all times. Immediate feedback was given as to whether each choice was an exemplar or non-exemplar of the concept. Eight concepts were presented in the task. Approximately ten subjects from both grades were in each of the four conditions.

During the course of concept attainment, in the selection conditions, the experimenter recorded the examples chosen by each subject, in the order that they
were picked. In the reception condition, as the experimenter pointed to a card, the correctness of each response made by the subject was recorded. Criterion for all conditions was four consecutive correct responses. To insure that the subject knew the concept, he or she was also required to tell what he thought the concept was after criterion level was reached. Subjects either had to correctly select four examples of the concept consecutively or accurately respond as the experimenter pointed to examples or non-examples of the concept. If a subject could not verbalize the concept, he/she continued selecting examples until the concept was correctly identified.
RESULTS

The dependent measure obtained from the concept formation task and used in the regression analysis was the mean number of trials a subject needed to achieve the criterion of four consecutive correct responses. Before this average could be used as the dependent variable, it was necessary to demonstrate that there were no interactions between concepts and the treatment or learner variables. A 2 (presentation mode) x 2 (instructions) x 2 (grade) repeated measures analysis of variance was performed and indicated that while performance varied significantly over the eight concepts, $F(7,518) = 7.76$, $p<.001$, no interactions were significant. Table 1 presents a summary of the findings. That some concepts were more readily learned than others is not surprising. Of importance in this analysis, however, was that all subjects, regardless of the condition or grade they were in, showed similar patterns of performance over the trials. No interactions with respect to the repeated measures were significant, thus it was considered appropriate to average the number of trials to criterion over the concepts and to use this measure as the dependent variable in further analyses.

Independent variables included three classification variables (presentation mode, instructions, and grade) as
### TABLE 1

Analysis of Variance Summary Table for Dependent Variable: Repeated Measures

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation Mode</td>
<td>1</td>
<td>816.33</td>
<td>5.66*</td>
</tr>
<tr>
<td>Instructions</td>
<td>1</td>
<td>110.21</td>
<td>0.76</td>
</tr>
<tr>
<td>Grade</td>
<td>1</td>
<td>20.58</td>
<td>0.14</td>
</tr>
<tr>
<td>Presentation X Instructions</td>
<td>1</td>
<td>269.48</td>
<td>1.87</td>
</tr>
<tr>
<td>Presentation X Grade</td>
<td>1</td>
<td>106.88</td>
<td>0.74</td>
</tr>
<tr>
<td>Presentation X Instructions X Grade</td>
<td>1</td>
<td>131.28</td>
<td>0.91</td>
</tr>
<tr>
<td>Subjects</td>
<td>74</td>
<td>144.30</td>
<td></td>
</tr>
<tr>
<td>E (Repeated Measures)</td>
<td>7</td>
<td>386.31</td>
<td>7.79**</td>
</tr>
<tr>
<td>Presentation X E</td>
<td>7</td>
<td>51.87</td>
<td>1.05</td>
</tr>
<tr>
<td>Instructions X E</td>
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<td>55.96</td>
<td>1.13</td>
</tr>
<tr>
<td>Grade X e</td>
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<td>77.30</td>
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</tr>
<tr>
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<td>54.60</td>
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</tr>
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<td>Subjects X E</td>
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<td></td>
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*p ≤ 0.02  
**p ≤ 0.001
well as a number of continuous variables (linear combinations of HFF error and latency and latencies on the ADM). Typically in research studies of fast/inaccurate-slow/accurate (traditionally labeled impulsive or reflectives), the continuous variables of latency and error are dichotomized by a median split procedure. Subjects are classified as either fast/inaccurate or slow/accurate, based upon performance on the Matching Familiar Figures task. A loss of information, thus of power in one's statistical analyses, is a concomitant of such a dichotomization (Ault, Mitchell, and Hartmann, 1976). A continuous variable, originally having a range of essentially infinitely many values, now only has at most four values (e.g. fast/inaccurate, slow/accurate, fast/accurate, slow/inaccurate). Although Kerlinger and Pedhazur (1973) state that designs can be conceptualized utilizing such a technique, to analyze the problem in such a manner leads to inaccuracies because of this sacrificed information. Tested relationships may fail to be of significance when in actuality they are significant beyond a chance level (a Type 2 error). Use of a multiple regression procedure allows errors and latency (or their linear combinations) to be analyzed more accurately as continuous variables, thereby avoiding placement of subjects in discrete groups. Such a design enables
different kinds of variables (classification and continuous) to be handled with equal power (Kerlinger and Pedhazur, 1973).

In place of using the basic variables, MFF error and latency, as predictors of the dependent measure, two linear combinations of error and latency were developed and entered into a regression equation. The rationale for using this technique lies in the observation that the cognitive style dimension, slow/accuracy-fast/inaccuracy, is not adequately determined by MFF latency alone nor by error alone. However, error and latency in combination would allow for a finer grained analysis than does the method of grouping people in one or another category based upon raw latency and error scores. Conceptually, individuals are considered to vary along a continuum dealing with this aspect of cognitive style, more or less reflective, for example. Such a procedure of assigning an individual a score on a continuum of values is more congruent with the dimension of fast/inaccuracy-slow/accuracy than is a dichotomization procedure. Thus a linear combination of both error and latency (i.e. a single continuous variable) was generated for the purpose of more directly and elegantly dealing with this stylistic dimension.
This first combination generated was the weighted difference between the error (E) and latency (L) scores, termed DIFF: \( E - (sERR/sLAT) \times L \). The weighting factor, \( (sERR/sLAT) \), was the ratio of the standard deviations of error and latency in this sample and was included in order to equalize the contribution of both variables to the composite. Such a weighting system was consistent with much of the literature in this area of cognitive style which considers error and latency to be equally important when determining fast/inaccurate or slow/accurate orientations. Thus, this system of weighting allowed for such a balance between these two values. If an individual had both a high error score and a low average latency, the resultant linear combination would be high. This is comparable to performance commonly termed fast/inaccurate. An individual with high latency and low error scores (i.e. slow/accurate) would have a low score. This linear combination could be considered analogous to the quadrants referred to as slow/accuracy-fast/inaccuracy (reflection-impulsivity) in the traditional dichotomization procedure. However, it is a more accurate indication of an individual's style than that provided by a median split procedure.

A second linear combination (labeled SUM) was the addition of similarly weighted error and latency scores on
the MFP: $E + (sERR/sLAT)*L$. In this case, high values indicated that many errors were made but also that responding was slow. Such performance would suggest that the individual had difficulty with the task or displayed incompetency. A low score reflects a fast/accurate orientation, or a competency aspect of his/her performance. SDH scores are likened to the off-quadrants of the typical dichotomization procedure (slow/inaccurate-fast/accurate) in this area of research. These aspects of MFP performance have been essentially ignored in the literature. Scores on this dimension would place an individual along such a competence-incompetence continuum, unconfounded with the cognitive style dimension under consideration in this study. The weighting factor which gave equal contribution to error and latency also ensured that these two linear combinations were orthogonal. Therefore, as a result of forming these linear combinations, an ability dimension and a stylistic performance (fast/inaccurate-slow/accurate) dimension were teased apart and then separately analyzed. These continuous variables were included as predictors of the dependent variable in regression analyses.

A correlation matrix was computed for the predictor variables and the dependent measure involved in this study. Predictor variables were presentation mode, instructions, grade, and performance on the MFP task and the ADM. The
measures significantly correlated with the dependent variable were presentation mode (r = .29, p<.008) and SUM (r = .28, p<.01). No correlations of the dependent measure with MFF error, MFF latency, DIFF, nor performance on the ADM approached a significant level. These correlations are presented in Table 2. Means and standard deviations are presented in Table 3.

Used as predictors of the dependent variable (average number of trials to criterion) in the first regression analysis were the classification variables and their interactions as well as three continuous variables, DIFF, SUM, ADM performance, and all interactions of DIFF with presentation mode, instructions, and grade level. Mode of presentation of the concepts was found to be significant, F(1,62) = 4.15, p<.04. The condition in which subjects controlled stimulus choice (selection) yielded fewer trials to criterion than did a reception condition. The means for the selection and reception conditions were 7.25 and 9.72, respectively. The linear combination labeled SUM approached significance, F(1,62) = 3.08, p<.08, suggesting the possibility that position on this dimension of speed and accuracy may be a predictor of the dependent variable. No main effects for other classification variables, nor for DIFF were significant. Also, no interactions of DIFF with the other variables approached significance. A summary
<table>
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<th></th>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
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<th>(H)</th>
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<td>0.12</td>
</tr>
<tr>
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<td>0.00</td>
<td>-0.04</td>
<td>0.09</td>
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<td>-0.02</td>
<td>-0.07</td>
<td>0.13</td>
<td>0.07</td>
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<tr>
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<td>0.05</td>
<td>-0.19</td>
<td>-0.30*</td>
<td>-0.29*</td>
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<td>0.01</td>
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<td></td>
</tr>
<tr>
<td>to Criterion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIFF</td>
<td>1.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>SUM</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

*p ≤ .01
### TABLE 3

Average Number of Trials to Criterion for Each Condition

<table>
<thead>
<tr>
<th>Grade 4</th>
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<th></th>
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<tbody>
<tr>
<td>1) Selection - No Instructions:</td>
<td>7.72</td>
<td></td>
</tr>
<tr>
<td>2) Selection - Instructions:</td>
<td>7.34</td>
<td></td>
</tr>
<tr>
<td>3) Reception - No Instructions:</td>
<td>9.87</td>
<td></td>
</tr>
<tr>
<td>4) Reception - Instructions:</td>
<td>10.27</td>
<td></td>
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<table>
<thead>
<tr>
<th>Grade 6</th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>1) Selection - No Instructions:</td>
<td>6.72</td>
<td></td>
</tr>
<tr>
<td>2) Selection - Instructions:</td>
<td>7.20</td>
<td></td>
</tr>
<tr>
<td>3) Reception - No Instructions:</td>
<td>7.51</td>
<td></td>
</tr>
<tr>
<td>4) Reception - Instructions:</td>
<td>11.31</td>
<td></td>
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</table>

Means and Standard Deviations for Other Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
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</thead>
<tbody>
<tr>
<td>MFF Error</td>
<td>6.30</td>
<td>4.34</td>
</tr>
<tr>
<td>MFF Latency</td>
<td>15.33</td>
<td>7.09</td>
</tr>
<tr>
<td>ADMa(first 1/3 ADM)</td>
<td>4.12</td>
<td>1.50</td>
</tr>
<tr>
<td>ADMb(second 1/3 ADM)</td>
<td>4.94</td>
<td>1.57</td>
</tr>
<tr>
<td>ADMc(last 1/3 ADM)</td>
<td>3.87</td>
<td>1.57</td>
</tr>
<tr>
<td>Average Number of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trials to Criterion</td>
<td>8.51</td>
<td>4.34</td>
</tr>
<tr>
<td>DIFF</td>
<td>0.37</td>
<td>12.93</td>
</tr>
<tr>
<td>SUM</td>
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<td>5.82</td>
</tr>
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</table>
### Table 4
Analysis of Variance Summary Table for Dependent Variable: Ave. # of Trials to Criterion

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<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>R-Square</th>
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</thead>
<tbody>
<tr>
<td>Regression</td>
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<td>19.39</td>
<td>1.04</td>
<td>0.24</td>
</tr>
<tr>
<td>Error</td>
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<td>1157.43</td>
<td>18.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>81</td>
<td>1525.85</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Partial Source**

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<th>Sum of Squares</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation Mode</td>
<td>1</td>
<td>77.54</td>
<td>4.15**</td>
</tr>
<tr>
<td>Instructions</td>
<td>1</td>
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<td>1.17</td>
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<tr>
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<td>0.03</td>
</tr>
<tr>
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<td>38.16</td>
<td>2.04</td>
</tr>
<tr>
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<td>0.17</td>
</tr>
<tr>
<td>Instructions X Grade</td>
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<td>14.98</td>
<td>0.80</td>
</tr>
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<td>Presentation X Instructions X Grade</td>
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<td>4.23</td>
<td>0.23</td>
</tr>
<tr>
<td>DIFF</td>
<td>1</td>
<td>2.12</td>
<td>0.11</td>
</tr>
<tr>
<td>SUM</td>
<td>1</td>
<td>57.65</td>
<td>3.09*</td>
</tr>
<tr>
<td>ADM (First 1/3 of ADM)</td>
<td>1</td>
<td>1.05</td>
<td>0.06</td>
</tr>
<tr>
<td>ADME (Second 1/3 of ADM)</td>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>ADMC (Last 1/3 of ADM)</td>
<td>1</td>
<td>7.16</td>
<td>0.38</td>
</tr>
<tr>
<td>Presentation X DIFF</td>
<td>1</td>
<td>0.33</td>
<td>0.02</td>
</tr>
<tr>
<td>Instructions X DIFF</td>
<td>1</td>
<td>5.03</td>
<td>0.27</td>
</tr>
<tr>
<td>Grade X DIFF</td>
<td>1</td>
<td>3.71</td>
<td>0.20</td>
</tr>
<tr>
<td>Presentation X Instructions X DIFF</td>
<td>1</td>
<td>2.49</td>
<td>0.13</td>
</tr>
<tr>
<td>Presentation X Grade X DIFF</td>
<td>1</td>
<td>1.98</td>
<td>0.11</td>
</tr>
<tr>
<td>Instructions X Grade X DIFF</td>
<td>1</td>
<td>7.05</td>
<td>0.38</td>
</tr>
<tr>
<td>Presentation X Instructions X Grade X DIFF</td>
<td>1</td>
<td>5.67</td>
<td>0.30</td>
</tr>
</tbody>
</table>

*P ≤ .10

**P ≤ .05
table of these results is shown in Table 4.

**Strategies used by subjects in the selection condition**

Because subjects in the selection conditions were responsible for choosing the concept instances themselves, it was possible to delineate the actual strategy used by them when learning the concepts. For these subjects, the number of times a focusing approach was employed was recorded for the eight trials. This was analyzed in a multiple regression analysis with instructions, grade, DIFF, SUM, and interactions entered as predictors of the new dependent variable, number of focusing responses. This analysis would determine whether or not the particular strategy used was influenced by instructions given or by other subject characteristics. No significance was obtained in this analysis as can be seen in the summary table shown in Table 5. Regardless of treatment condition, grade level, or cognitive style, approximately equivalent numbers of focusing strategies were used in the concept task.

**Relationship between MFP and ADM performance**

Performance on the attention task, the ADM, was divided into thirds. Average time to locate each number for each third of the task was recorded and correlated with performance on the MFP (i.e. latencies and errors). The results indicated that latencies on the ADM did not
TABLE 5

Analysis of Variance Summary Table for Dependent Variable: Focusing Strategy Usage

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>R-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>8</td>
<td>0.98</td>
<td>.84</td>
<td>.117</td>
</tr>
<tr>
<td>Error</td>
<td>31</td>
<td>1.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructions</td>
<td>1</td>
<td>0.63</td>
<td>0.33</td>
</tr>
<tr>
<td>Grade</td>
<td>1</td>
<td>0.25</td>
<td>0.01</td>
</tr>
<tr>
<td>Instructions X Grade</td>
<td>1</td>
<td>0.25</td>
<td>0.01</td>
</tr>
<tr>
<td>DIFF</td>
<td>1</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>SUM</td>
<td>1</td>
<td>0.53</td>
<td>0.28</td>
</tr>
<tr>
<td>Instructions X DIFF</td>
<td>1</td>
<td>0.12</td>
<td>0.06</td>
</tr>
<tr>
<td>Grade X DIFF</td>
<td>1</td>
<td>5.28</td>
<td>2.77</td>
</tr>
<tr>
<td>Instructions X Grade X DIFF</td>
<td>26</td>
<td>0.66</td>
<td></td>
</tr>
</tbody>
</table>
correlate significantly with MFF latencies, errors, or with the linear combinations, DIPF and SUM. Thus, rate of responding on this measure of attention was not related to latency of response on the MFF, nor with accuracy of performance. These correlations are shown in Table 2.
DISCUSSION

The results of this study did not support the hypotheses initially presented. None of the principal hypotheses concerning the relationship of the cognitive style dimension of fast/inaccuracy-slow/accuracy to performance on the concept formation task were substantiated. The major hypotheses follow as do the findings obtained from data analyses relating to these predictions.

Presentation modes: Selection versus reception

Variation in the manner by which concept instances were presented to the subjects was included in the design to shed light on some of the differing results found in the literature. Huttenlocher (1962) observed that reception procedures allowed twelve year old children more efficient performance on a concept solving task than did a selection paradigm. With adults, Hunt (1965) found that quicker concept attainment occurred when subjects selected their own concept instances. In this study, age levels not previously tested (nine and eleven years) were included in order to determine whether a selection condition is facilitative only for adults and that children use information obtained from a reception procedure more efficiently than from a selection condition.
Results indicated that a selection paradigm yielded significantly fewer average trials to criterion than a reception mode. This parallels the previous findings dealing with adult performance on concept acquisition (Hunt, 1965). It appears that by the time an individual is in the fourth grade, he/she is more proficient at forming concepts when allowed to freely choose the concept instances to be tested than when the experimenter presents these instances. This contradicts Huttenlocher's (1962) findings that indicated that twelve year olds perform better when presented instances of the concepts. However, the task requirements in the two experiments were not identical, nor were the concepts to be learned. Instructions varied and the mode of presenting concepts was dissimilar. The individual was shown actual objects and not simply pictorial representations of geometric figures as in the present study. Such task differences may have produced these discrepant findings. If there is an age at which reception modes are more beneficial than selection procedures, results of this study did not indicate when that would be. No research exists which directly compares young children (seven to eight years) with older age groupings. Therefore, what may be said concerning presentation mode based upon present results is that a selection procedure facilitates performance on conjunctive
concepts, at least by the fourth grade level.

Possible reasons for the beneficial effect of selection conditions can be considered. When such a paradigm is employed, it is suggested that an individual is 'forced' to increase his/her attention to the task (Bourne et al., 1971). This demand for attention may elicit more activity on the part of the subject, intensifying his/her involvement. An individual's motivation and orienting response to the task would play a role in successful task performance. Better performance would be produced if cognitively the individual is also exerting greater effort to obtain information when solving the problem, more effort than when simply receiving information as in a reception condition. In such a situation, a subject may actively consider what the task is and which card choices would help him/her more quickly and accurately discover the concept. This finding indicates that selection modes are advantageous to performance. Superiority of selection modes would also result if individuals have a difficult time adapting to and employing someone else's strategies and prefer to use their own strategies and activities in a learning situation.

In the reception paradigm, instances were presented in what has been considered an optimal (focusing) approach (Laughlin, 1975). When such a strategy is employed,
sufficient information to determine the concept is gathered in the fewest number of trials. However, subjects did not benefit from receiving information in this manner in the present study. Even when informed initially of what procedure the experimenter was using (i.e. in the instructions condition), performance was not enhanced. This order of presentation may diverge too much from the approaches fourth and sixth graders would commonly use. If such an approach is not familiar to them they may not utilize the information efficiently and may even find it difficult to follow the experimenter's strategy. If subjects are allowed a training period, not merely information or instructions concerning the presentation order, it is possible that they would become more accustomed to a focusing strategy. Such familiarity with this strategy could eliminate initial uncertainty concerning how cards are shown and therefore decrease trials to solution.

No instructions versus instructions

The hypothesis that instructions given at the beginning of the task would benefit the subjects was not upheld. Instructions informing the subjects of an efficient way to discover the concepts (when selecting their own instances) and explanations of the method of presenting concept instances (reception condition) had
negligible effect on efficiency of concept acquisition. Additionally, when the strategies used in selection conditions were analyzed, subjects given instructions did not focus more frequently than those receiving no instructions.

Instructions thus appear to have failed to modify cognitive approaches and to enhance performance. The strategies that were more familiar to these subjects were possibly employed regardless of the assistance given in the instructions. These aids may not have been sufficiently descriptive of focusing behavior to guide the subjects to adopt such a procedure or to summarize the information obtained in the process. Alternatively, instructions to use a focusing strategy may have failed if they led to confusion, causing subjects to abandon or ignore the focusing suggestions at the outset of the task. The results do not rule out the possibility that with a very detailed description of focusing behavior accompanied by a period of training, such instructions and practice could aid task performance.

The cognitive style dimension of fast/inaccurate-slow/accurate was not related to this instructional manipulation as hypotheses predicted. Sola and Phye (1976) found that fast/inaccurates did significantly better at item recall on a classification
task when told to use a particular strategy than when left to their own devices. Slow/accurates, on the other hand, did better without strategy instructions. Contrary to the hypothesis based upon this finding, individuals who tended to be more fast and inaccurate did not benefit from instructions to use a focusing approach more than did slow/accurates. Subjects in both conditions tended to use scanning strategy for approximately six of the eight concepts. Lack of a relationship between this dimension of cognitive style to the instructions condition may be in part related to the earlier cited criticisms of the incompleteness or confusing nature of these instructions. Any potential instructional effect interacting with cognitive style may have been eliminated by an ineffective experimental manipulation.

**Grade differences**

McKinney's (1975) research indicated that developmental differences appear on problem solving tasks at the ages included in the present study. In particular, between nine and eleven years of age, slow/accurates showed a pattern of continued improvement while fast/inaccurates showed little or no gain in problem solving efficiency. In this study, the hypothesis based upon these findings concerning performance differences of fourth and sixth graders was not upheld. Their criterion performance was
comparable in all experimental conditions. Also, older subjects in selection conditions did not use more focusing strategies in the task than the younger subjects. It appears that individuals at these age levels have similar levels of attention and orienting as well as comparable strategies, all of which are reflected in such concept formation tasks. It may have been necessary to use a wider age range in order that performance differences could emerge. Addition of a third age level (i.e. second graders) may have yielded more information on this matter, allowing for greater developmental variability in cognitive abilities.

Relationship of cognitive style to task performance

Contrary to the hypotheses, this dimension of cognitive style (fast/inaccurate-slow/accurate performance) was not related to the number of trials to criterion on the concept formation task developed for this study. Predictions were that fast/inaccurate individuals would require more trials than slow/accurates in the process of concept acquisition. Such results were expected if less well-developed strategies were characteristic of those who are more inaccurate and quicker in responding. Focusing strategies have been found to reduce the number of trials to solution in a variety of tasks (McKinney, 1975). If the literature is correct in stating that fast/inaccurate
individuals are less analytic, do not survey the entire stimulus situation, and do not consider alternative solutions to a task (Kagan et al., 1966; Drake, 1970; Egeland, 1975), one would expect that strategies which efficiently use information obtained would be less likely to develop or would be slower in developing (McKinney, 1975; Laughlin, 1975). However, no performance differences related to cognitive style were obtained either when considering the average number of trials to criterion as the dependent variable or when actually analyzing the strategies used.

Developmentally, the hypothesis was that a younger (fourth grade) individual who could be characterized by the MFF as slow and accurate in orientation would perform with accuracy similar to a sixth grader who rapidly responds yet is inaccurate. No relationship was observed between DIFF, age, and task performance which would uphold this hypothesis. Also, no support was given the hypothesis that fast/inaccurate subjects would perform better under a reception paradigm than in a selection situation. Additionally, the experimental manipulation of adding instructions to correct the hypothesized immature strategies did not decrease the number of trials to criterion nor increase focusing. If these experimentally imposed manipulations add structure or support, predictions
were that an individual using less developed cognitive strategies would have displayed increased efficiency when compared with others who already may use effective manners of surveying the task and obtaining information. None of these suggestions was supported. When strategies were also considered, results did not substantiate the prediction that individuals of a fast/inaccurate orientation actually do have less developed, inefficient cognitive strategies than other subjects.

Prior to rejecting these hypotheses in total, however, the experimental task must be scrutinized. McKinney (1975) found that with too easy or with overly difficult tasks, no differences in performance occurred in those individuals of different cognitive styles. The lower variance of these tasks would lessen chances of obtaining differences between experimental groups. Literature in this area does not give an indication of the level of task difficulty that would be optimal for one to obtain differential performance on the part of those who are quite fast and inaccurate and those whose orientation is slow/accurate. A route for further research could include varying levels of task difficulty while employing the same stimulus materials and procedures, e.g. a concept formation task with concepts defined by both two and three relevant attributes. This may give an indication of the point at which the level of difficulty is
too low or becomes too great to allow for performance differences between those of divergent cognitive styles.

Another task consideration would be that the task was 'unusual' enough so that subjects may not have employed the same strategies they use in typical educational settings. Non-geometric figures and concepts are the rule in everyday situations, whereas those used in this task were uncommon concepts. The contrived experimental method may have elicited strategies that were not representative of their usual manners of learning. Slow/accurates and fast/inaccurates may have performed alike, yet not using their typical approaches to a new stimulus situation. Also, the experimental task presented the concept instances in a highly organized fashion, not in the way concept instances are normally presented to an individual. A randomized presentation order may elicit differential strategies in individuals of varied cognitive styles or grade levels.

**MFP performance and the ADM (attentional) measure**

The idea presented at the outset of this study that people whose orientation tends towards a fast and inaccurate style are 'plagued' with attentional deficiencies was considered. None of the findings of this study support this suggestion. One could possibly argue that the novelty of the experimental task itself may have
sufficiently compensated for the suggested deficiencies in attention, reducing the performance differences between those of varying positions on the cognitive style dimension. However, this notion that there are actual attentional differences may be called into question. Considering ADM performance, no correlation was found between latency on this measure and latency or errors on the MFF, nor with their linear combinations, DIFF and SUM. Analysis of the relationship between the fast/inaccurate-slow/accurate dimension and ADM performance leads one to question these suggestions of different attentional patterns, since no relationship appeared. The possibility does exist, however, that another more direct and sensitive measure of attention may reveal differences between individuals of various cognitive styles. Since the ADM was a relatively brief scanning task, different types of attention tasks which span a longer period of time may allow for fast/inaccurates to display the suggested inability to sustain attention (Weiner, 1975).

Significance of the linear composites, DIFF and SUM

Of interest in this study was the development of orthogonal linear composites based upon the subjects' MFF error and latency scores. Such a composite allowed their scores to remain on a continuous scale, retaining accuracy
and avoiding the loss of information which occurs when dichotomizing data. This dichotomization is the traditional practice with respect to cognitive style, fast/inaccuracy-slow/accuracy. Using these linear composites, values along the DIFF and SUM dimensions are obtained by all individuals and no classification is involved. Such a procedure eliminates the possibility of misclassification or changes in classification upon retesting. For instance, Egeland and Weinberg (1976) studied the credibility of the HFF test and found that 20% of those subjects designated as reflective (slow/accurate) and 50% of the impulsive (fast/inaccurate) subjects changed classification at a second testing. Based upon their observations, suggestions dealing with the creation of linear composites of error and time were presented. Such a procedure creates a composite which is more reliable than are error and latency independently. This composite is more reliable (reliability = .61) only with respect to DIFF, however, since it is actually a summation and not a difference score. SUM, on the other hand, does not share in this increased reliability. This technique also allows for the use of multiple regression analyses, which were performed in the present study. As was previously mentioned, accuracy is increased with respect to the statistical analyses when classification in discrete
categories is avoided.

Forming linear composites of error and latency allowed for the creation of two components of HFF performance, labeled DIFF and SUM. Individual analyses of these two aspects of an individual's HFF performance, his/her task competency as well as the primary consideration, his/her stylistic orientation, could then be conducted. Results of the present study found no relationship between one's cognitive style or task orientation (fast/inaccuracy-slow/accuracy) and concept formation efficiency nor with the strategies used while solving the experimental problem. Equivocal results of previous studies regarding the relationship of cognitive style and a variety of cognitive tasks may have resulted from unreliability produced by dichotomizing HFF data. The present technique of creating linear composites may be used in future research studies in this area, eliminating the statistical problems plaguing present research analyses.

The linear combination termed SUM was the sole aspect of HFF performance found to be marginally related to efficiency on the concept formation task. This aspect of a subject's abilities was considered comparable to a competency aspect of an individual's cognitive behavior, rather than the stylistic orientation. Comparison of this aspect of an individual's performance with general
intellectual abilities (such as IQ) is necessary. If there is a relationship, interpretation of findings dealing with SUM may become easier and clearer. If this dimension, orthogonal to DIFF, does represent a person's general ability, then separate and independent analyses of two aspects of one's behavior, as measured by the MFF, can be made. This seems a viable direction to pursue with respect to cognitive style research.

Considering the criticisms of the experimental task, it would be difficult to conclusively state that the hypotheses made at the outset of this study with respect to cognitive styles are totally incorrect. In any case, the overall absence of a relationship between this dimension of cognitive style and task performance and the lack of effect due to the experimental manipulations (as were hypothesized to relate to cognitive style) is puzzling. One consideration is the generalizability of this dimension as measured by the MFF to a task such as was employed in the present study. This dimension may remain a characteristic of performance found only on perceptual matching tasks. Block, Block, and Harrington (1974) suggest that generality of MFF performance is within a rather narrow class of cognitive tasks. On a concept formation task, then, there may be no relationship between observed MFF performance and efficiency of concept acquisition. Such limited value of
the resultant MFF scores needs to be scrutinized in the future. An additional area requiring exploration is the creation and use of linear composites based upon MFF scores. The potential increase in accuracy regarding cognitive style will allow greater precision with respect to the research analyses and fewer equivocal results concerning the importance of cognitive style for an individual.
REFERENCES


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Schvaneveldt, R. Concept identification as a function of probability of positive instances and number of relevant dimensions. *Journal of Experimental Psychology*, 1966, 72, 649-660.


Wason, P. Response to affirmative and negative binary statements. *British Journal of Psychology*, 1961, 52, 133-142. (b)


APPENDIX A:

CONCEPT INFORMATION

Concepts to be solved and the order of presentation in the concept-formation task:

1) Large Circles
2) Red Crosses
3) Two Squares
4) Three large objects
5) Green Squares
6) Medium-sized Blue objects
7) One Red object
8) Three small objects

Order of difficulty of the concepts and average number of trials to criterion for each concept:

1) Three small objects - 5.80
2) Green Squares - 6.30
3) Red Crosses - 7.25
4) Large Circles - 8.50
5) Three large objects - 9.10
6) Two Squares - 9.30
7) One Red object - 9.95
8) Medium Blue objects - 12.50
APPENDIX B:
INSTRUCTIONS

General instructions - given to all subjects in all conditions

"For this task I will have you figure out what it is I am thinking of. I will have in mind a particular concept which you are to guess. A concept is a way of grouping these cards in ways in which they are alike. For example, 'dog' is a concept. Many animals which look different in some ways but which are alike in other ways can be called 'dogs'. In what ways are dogs alike?" (A response was asked for. If none was given, help was allowed.) "In this game the concepts are somewhat different, however. The concept may be 'all red cards' or 'all cards with blue crosses' or 'all cards with two medium-sized objects'." (The subjects were given these concepts and were required to point to those cards which were examples of the given concept to insure understanding of the term concept as used in this task.) "The objects can change in four different ways. The color can change, so can the shape. The number on each card can change as well as the size of each object. The color can be red, green, or blue. Objects can be small, medium, or large and they can be squares, circles, or crosses. Also, there can be one, two, or three objects per card. Any combination of two of these characteristics
names my concept. For example, the concept may be blue crosses. What is that a combination of?" (Subjects then responded. If there was any difficulty, instructions were elaborated on in order to clarify and another example given.) "That is right, the color blue and the shape cross names my concept."

Instructions added for the subjects in a selection condition

"I will start you off by pointing to a card which is an example of the concept I am thinking of. Then you are to pick cards, one at a time, which you think may be examples of my concept. You will point to each card and then I will tell you if that is or is not an example of my concept. Continue to point to cards that you think are examples of the concept I have in mind until I tell you to stop. When I think that you know the concept, I will ask you what concept I am thinking about. In that way I will know that you have figured out the concept."

Instructions added for the subjects in a reception condition

"I will begin by pointing to a card which is an example of the concept I am thinking of. Then I will point to cards one at a time, and you are to tell me whether you think that they are examples of my concept. I will then tell you if your guess is correct. As I continue to point
to cards, you will say if they are or are not examples of my concept. This will continue until I think that you know what it is I am thinking of. I will stop you and ask you what you think the concept is. In that way I will know that you have figured out the concept."

**Additional focusing instructions for a selection paradigm**

"I will give you a hint how to go about this task. When I show you a card that is an example of the concept I am thinking of, keep it in mind. Change only one aspect (characteristic/part) of the next choice, and do this on each choice that you make. For example, say that I point to two large red squares and say that this card is an example of my concept. You could then point to another card that is almost the same, but which changes in one way. That is, the next card may be three large red squares. This changes only in the number of objects on the card. If I say 'Yes, this too is an example', compare this card with the card I showed you at the beginning (i.e., two large red squares). Since the number of objects is the only thing that is different on the two cards and since both are examples of my concept, you can figure out that number is not part of my concept. You may then pick another card that changes in only one other way for example, two small red squares. This changes only in size (the new one is small, the focus was large). If I say that this is not an
example, then you will know that size (large) must be important - that is, it must be part of my concept. Continue like this until I am certain that you know the concept I have in mind." (Another example was given as practice and to insure understanding.)

Additional focusing instructions for the reception paradigm

"I will give you a hint how to go about this task. When I show you a card that is an example of the concept I am thinking of, keep it in mind. I will then change only one aspect (characteristic/part) of the next card I point to and will do this on each choice that I make. For example, say that I point to two large red squares and say that this card is an example of my concept. I would then point to another card that is almost the same, but which changes in only one way from the focus card. That is, the next card may be three large red squares. This changes only in the number of objects on the card. If I say that this too is an example, then compare this card with the card I indicated to you at the start (i.e., two large red squares). Since the number is the only thing that is different on the two cards and since both are examples of my concept, you can figure out that number is not a part of my concept. The next card will change in only one other way - for example, two small red squares. This changes
only in size - the new one is small, the focus was large. If I say that this is not an example, then you will know that size (large) must be important, that is, it must be part of my concept. I will continue like this until I am certain that you know the concept I have in mind."

(Another example was given as practice and to insure understanding.)
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