ACQUIRING A CONCEPT OF PAINTING STYLE

ACQUIRING A CONCEPT OF PAINTING STYLE

by

Jean Cochran Rush

A Dissertation Submitted to the Faculty of the

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY

In the Graduate College

THE UNIVERSITY OF ARIZONA

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THE UNIVERSITY OF ARIZONA

GRADUATE COLLEGE

I hereby recommend that this dissertation prepared under my direction by **Jean Cochran Rush**

entitled **Acquiring a Concept of Painting Style**

be accepted as fulfilling the dissertation requirement of the degree of **Doctor of Philosophy**

John R Bergen — March 28, 1974

Dissertation Director — Date

After inspection of the final copy of the dissertation, the following members of the Final Examination Committee concur in its approval and recommend its acceptance:*

John R Bergen	3-28-1974
Barry J. Zimmerman	1-28-74
Terry Daniel	4-1-74

*This approval and acceptance is contingent on the candidate's adequate performance and defense of this dissertation at the final oral examination. The inclusion of this sheet bound into the library copy of the dissertation is evidence of satisfactory performance at the final examination.

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SIGNED: Jean Rush

ACKNOWLEDGMENTS

"Chimeras come singly and leave accompanied."

--Antonio Porchia, Voices

To all the friends and family who have been so supportive while I labored to bring forth this rather improbable offspring, I submit my thanks. I owe a considerable debt of gratitude to Dr. John Bergan, who first encouraged me to pursue the kind of investigation that, after a rather long time, eventually led to this dissertation.

I appreciate very much the consideration shown to me and to my efforts by Dr. Barry Zimmerman, with his interest and research in the area of concept formation; by Dr. Terry Daniel, with his insights into the signal detection process; and by Dr. Robert McMillan and Dr. Warren Anderson who, through their faith in my judgment, allowed me to pursue interests in a field not altogether compatible with their own.

I take special notice of the considerable time generously given to me by Mr. George Seeley, who magically produces favorable data analyses from computers, and without whom the entire project would have collapsed of its own weight. So many others have contributed time, ideas, or

energy toward the study, not the least of whom were the 120 cooperative students who enrolled in Art 103.

Finally, I thank Dr. Lawrence Wheeler, whose encouragement made the completion of this research possible, and whose sense of style made the description of it readable.

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ABSTRACT

The experiment was designed to teach college students a concept of painting style. Stimuli were slides of paintings by Manet, Renoir, Degas, and Lautrec. Learning (concept generalization) was measured by students' judgments of each painting as representing or not representing the work of the artist Manet, when slides of all four artists were viewed in random sequence. Responses were made using a ten-point certainty-of-response rating scale, and were analyzed according to a signal detection model.

Method

Subjects were 120 male and female non-art-major college students. Stimuli were 80 color slides of paintings, divided into three sets: training (20), immediate generalization (40), and posttest (20). Each set contained an equal number of slides by all four artists.

The experiment contained a training phase, immediately followed by a generalization test. Concept retention and delayed generalization were tested two weeks later, when subjects were also asked to state aesthetic preference and to generate verbal attributes defining the style of each of the four artists used in the experiment.

There were four training groups and two control groups, with twenty students in each group. There were two learning conditions, an active (guessing-feedback) and a passive (verbal modeling) condition. Within each active or passive condition there were three levels of information given to students: label-plus-rule (artist's name plus verbal style characteristics), label-only (artist's name), and control (no information).

Results

Immediate generalization, concept retention, delayed generalization, and aesthetic preference tests were structured according to signal detection theory. Manet was designated signal-plus-noise, and Renoir, Degas, and Lautrec were designated as noise alone. Data were examined by analysis of variance using raw rating scores, and a second analysis of variance was applied to the signal detection index of discrimination, d_m. The signal detection method separated effects of observer criterion states (expectancies, guessing bias, etc.) from the results, to give a clearer appraisal of learning.

Training Conditions

The active condition was significantly less effective than the passive condition in producing concept attainment. Subjects in the label-plus-rule condition were significantly more successful than were subjects in the

label-only condition, and both of these conditions performed significantly higher than subjects in the control condition. The passive label-plus-rule training group performed significantly better than the other three training groups. Patterns of group performance observed in immediate generalization were consistently retained after delay. The artist preferred by all groups was Renoir, although training did significantly affect likes and dislikes. The effect of giving rules during training was to inhibit the spontaneous generation of attributes relevant to concepts of style.

Discussion

For concepts in art, using complex nonverbal material with an aesthetic component, all of the instructional strategies examined were effective in producing concept attainment. The results suggest that the more information a subject receives, the better his performance on a complex concept-learning task is likely to be. Apparently teaching rules will enhance performance even when all of the stimulus dimensions cannot be specified. Verbal modeling proved more effective than guessing-feedback, where d_m analysis suggested that subjects in the active condition may have modified their guessing strategy but did not learn as effectively as subjects in the passive condition.

Main effects were significant after two weeks according to d_m analysis, but not according to mean ratings

analysis. This discrepancy was interpreted to mean that subjects' criterion states shifted as a result of delay. After two weeks, subjects were apparently less willing to risk being wrong, but were not less able to discriminate the non-target artists from Manet.

CHAPTER 1

PERCEPTION, COGNITION, AND ART EDUCATION

What is the nature of art education? What should it be? The training of artists is as old as the history of education. Teaching artists in any systematic way is considerably more recent. To accomplish this, we must know the skills an artist will need and devise strategies that will teach these skills.

Perceptual Learning and Art Education

To educate someone in art assumes that training to become an artist, one who is able to produce works of the type defined as fine art, rests primarily on his perceptual skill rather than on motor coordination or the ability to verbalize about the art object after it has been brought into existence. Art education also assumes that training which produces a person with enough visual skill to paint, to sculpt, to create in the visual mode, will generalize to any of the other creative uses to which perception is put by human beings.

Creativity in this sense is a kind of problem solving ability; and it is thought that an artist--a creative person--has a higher order of perceptual skills than human beings who are not artists. The word artist here

is used in its widest sense. To assume that perceptual training in the visual area will transfer to some extent to other modalities is to regard it as a form of concept generalization.

In art we recognize the existence of perceptual skills, but we do not fully understand their nature. We cannot indicate specifically which skills, if any, are taught by the various exercises we commonly employ to teach art. We need to be able to list them, and to put them into a hierarchy for teaching purposes.

Perception is a cognitive process that occurs invisibly and has to do with the "sense" or interpretations we make out of an essentially neutral and sometimes even chaotic world. To Dember (1960) perception refers to relations between output and input, both potentially observable. Trying to infer the principles on which the process works is essentially no different from that facing the person who tries to learn the rules of chess by watching the game played.

Having observed that adults operate perceptually in a more efficient way than children, we infer that perceptual ability is learned. Perceptual learning then refers to an increase in the ability to extract information from the environment, as a result of experience and practice with stimulation coming from it (Gibson, 1969). It also appears that perceptual skill increases with practice.

Although perceptual learning is assumed to occur, and many attempts have been made to isolate perceptual learning from its attendant behaviors, it is difficult to talk about its exact nature. Scientists who measure cortical electrical activity, for example, appear to be dealing with perception divorced from behavior (Pettigrew, Olson, and Barlow, 1973).

In U.S. psychology there is a body of literature on perceptual behavior compiled by Gibson (1969) in her book Principles of perceptual learning and development. Gibson considers perception to be an active, not a passive process. We look, we do not merely see; we listen, not just hear.

Furthermore, the process seems to occur without the necessity of external reinforcement. The impetus to refine perceptions may be the reduction of uncertainty. The opportunity to look is so intrinsically reinforcing that Harlow has used it as a reward to train monkeys in other tasks. A monkey enclosed in a cage without windows is reinforced by being allowed to look out (Gibson, 1969).

Perceptual learning, as with motor learning, is closely related to development. Much of Eleanor Gibson's work considers both, deriving hypotheses from observations of development that are then tested in an experimental laboratory situation. In her book she discussed both traditional and contemporary theories of perceptual learning and

related it to the other cognitive processes such as remembering, attaining concepts, and using language.

Thought and Verbal Processes

People proficient in a visual mode of expression often seem to feel that there is a difference between cognitive processes that operate in "reading" a visual statement and those that are used in reading a verbal one. The verbally oriented majority (scholars and academicians among them) have been slower to grasp the distinction. Part of the difficulty may be that every educated person in the United States has received enough training in verbal skills to be able to communicate at some level. Art education has been limited to the minority who display some aptitude ("talent") for picture making.

Whorf (1967) believes that the concepts and even the percepts of men are determined by the language of the culture in which they live. In our culture it is interesting to observe what we make out of our ability to look. Creativity we often define as the ability to see in new ways. We indicate our understanding by the term I see. Seeing, as we all know, is believing. Grasping the solution to a problem may be termed insight. Whorf sees in the patterns of language the tangible expression of man's cognitive structure.

Words are important because of the added scope they give to thought. Words are referents for images that become increasingly abstract. Words are useful cues for retrieving images from memory. They provide signs for concepts, words by which things are named as categories. Many categories involving increasing levels of abstractness may be applied to one object. A cat is an animal, a mammal, a feline, a domestic cat, my cat Pisces (Arnheim, 1969). The painter Georges Braque is quoted by Arnheim as saying, "A coffee spoon near a cup acquires at once a different function when I place it between my heel and my shoe. It becomes a shoe-horn" (p. 238).

Words tend to suggest functional relationships. Logic and reasoning connect perceptual images at different levels of abstraction and relate things not related in the physical world of space and time. The verbal statement solidifies the more precarious, abstract image.

Words are limited by their linear, one-dimensional relationship to each other. They come in a string; they evoke images, but do not duplicate the spatial relationships involved. It takes many strings of words to describe one image. The image is available to the mind as a whole, entire, simultaneous.

It is also possible to use words without understanding their meaning because they are not rooted in perceptual experience. A third grade child who is taught the

phrase "Gasses expand when heated" has not necessarily been taught the concept that it implies, if he has no perceptual experience of the event to which it refers.

Visual Thinking

The role of image rather than word in the cognitive process is presented by the psychologist Arnheim (1969) in his book Visual Thinking. The title refers to Arnheim's hypothesis that thought is not verbally mediated as is so often believed, but used mental imagery, a nonverbal process depending directly on sensory information.

This is a view still not commonly held by American psychologists, who, because of their intellectual tradition, put a great deal of emphasis on behavioral observation. Much of their work on concept formation has employed verbal behavior, thought to be measurable and therefore manageable in an empirical study in a way that images are not. Words are commonly assumed to be the mediators for S-R connections, or meaning is often defined in terms of verbal associations.

Paivio (1971) points out, however, that verbal processes are used by contemporary psychologists to infer the nature of human thought, just as images are used.

> The problem in the case of both of these postulated processes is to clarify their functions, that is, to determine the conditions under which mental images and mental words are aroused and to identify the nature of their effects on overt behavior. Both are theoretical constructs and whether or not it is useful to postulate either, or both, depends on the adequacy of the defining operations and the research

> procedures used to test the properties that have been theoretically attributed to them (p. 6).

Two Americans who did early work in this field were William James and Edward B. Titchener, who developed the "associative view" that memory images can be evoked by stimuli with which the imaged objects or events have been associated in the past, and that these images themselves combine associatively.

Arnheim's (1969) image theory of meaning can be regarded as an extension of such associationistic views to the domain of language, with words presumably serving as cues for the arousal of the memory image. An example: I say the word "car" and an image of car, the concept car (not necessarily a specific car) springs to mind. The crucial point about such experiences is that the eliciting question and the behavioral expression of recall may be entirely verbal, but the mediating mechanism apparently consists of imagery associatively evoked by the words.

Such views have been extended to the interpretation of perception as a combination of sensation and memory images, and to thought in general as the manipulation of mental imagery. Memory, meaning, association, thought--all of these, according to Arnheim (1969) implicate mental imagery as a crucial mechanism.

Experimental concept formation tasks are based on sensory data, using shapes that vary along the dimensions of

color, size, area, etc. Perception is the mental grasping of structural features found in, or imposed upon, the object. To Arnheim, shapes are concepts. Abstracting stimulus features, called generalization or concept formation, is, according to Arnheim, accomplished nonverbally.

To an artist, one who manipulates visual building blocks, and to anyone interested in the education of others in similar skills, Arnheim offers a provocative verbal analysis of the process of visual thinking. In discussing the role memory plays in the perceptual-cognitive process, he quotes Raphael writing to his patron,

> In order to paint a beautiful woman I should need to see several fair ones, and you would have to help me with the selection; but since fair women and competent judges are rare, I make use of a certain idea that comes to mind (Arnheim, 1969, p. 98).

An artist manipulates external elements but judges by some internal standard.

The nature of images is both particular and generic. Particular images--complete in every detail--are rare. There are two types. One we refer to as eidetic imagery, or photographic memory. This is more common in children under ten, some estimates being as high as 40%, and is also known in some adults. This phenomenon produces behaviors like committing a map to memory in such a way as to be able to read off the names of towns. In these cases, eye movements have been recorded as though the subject were actually looking at the picture. The other form of complete image

has been produced by electrical brain stimulation, which is not so much like remembering as reliving an actual experience, complete with smells, sounds, and sights.

Generic images are the type needed for thought. They take things out of context, they abstract qualities apart from the object, they are incomplete. The incompleteness is derived from the function of our selectively discerning minds--catching salient features. Imagine an arm without a body; the feeling of softness without the feather pillow. The mind cuts pieces from the cloth of memory; it makes collages; it imagines centaurs, griffins, and unicorns.

Perhaps it is precisely this quality of generality that allows us the freedom to think. Edward Titchener (1969) described his mind as a picture gallery, not of finished paintings, but of what he termed impressionist notes, operating in hints and flashes.

This excursion into the nature of the cognitive process is intended to suggest that thought goes on nonverbally, not that we can do without words. Animals do not have the power of speech, yet it has been demonstrated that they exhibit conceptual behavior. Harlow has taught monkeys the oddity concept and transferred it from one problem to another (Gibson, 1969). The conceptual limitations of animals is not necessarily due to their lack of language.

Conclusion

Perceptual skills are a part of human cognition, the total thought process that distinguishes man as unique among animals. Perception is an active process. Perception is the process of getting first hand information about the world, our environment, through the only channels available to us, those of our physical senses. There are surely many approaches to full participation in this desirable state. Visual art is only one such approach, but it is by no means less important for that reason.

In the United States, education for adults at the university level is distinct from that for children in the elementary and high schools. The universities attempt to produce artists, on the assumption that anyone who can engage in the production of art can somehow communicate it to others. Instructors in the studio courses are required to be practicing artists.

The lower schools present art as avenues for self expression related to growth and for developing perceptual and motor skills (Lowenfeld and Brittain, 1970; McFee, 1970). Instructors may or may not be trained in art, but they are expected to have empathy with children. Art in the former case has a very specific meaning; in the latter, a very broad one.

Adults and children differ in their needs and it is not possible to discuss art education in terms of a program

that will be adequate for both groups. Rather, it is possible to discuss programs for both adults and children in terms of teaching perceptual skills. It is the responsibility of people teaching in the arts to work toward understanding the ways in which this visual mode is representative of cognition. There are hierarchies of skills to be developed, experiences to be structured to make learning more likely to occur.

CHAPTER 2

THE EXPERIMENTAL QUESTION

What is the nature of art education? To train artists in any systematic way, we must know the skills an artist will need and devise strategies that will teach these skills. Art education can make use of the information that current research in psychology can supply. There is pertinent material available in the psychology of perception, experimental aesthetics, social learning, and concept formation literature, among others. Psychology can provide a method for unbiased observation of art-related behaviors to help increase knowledge in this regard. Art teachers need to be more familiar with this literature because it offers help in finding solutions to specifically art-related problems.

Learning to discriminate styles of painting is a concept formation task. Art students are taught to distinguish one painter's work from that of another on the basis of his style. A concept of a man's style may be learned so well that a painting never seen before can be accurately attributed to him on the basis of its stylistic characteristics.

Courses in art history usually teach style concepts by presenting the student with a number of examples, labeling them according to painter, and providing rules for concept formation by verbally defining relevant attributes. According to Walk (1967) this type of concept formation is similar to probabilistic cue experiments reported by Bruner, Goodnow, and Austin (1956).

At present the relative merits of instructional strategies designed to teach concepts of art style are not well understood. A great deal of current research makes it seem worthwhile to investigate whether or not traditional teaching paradigms are the best ones to use with style concepts.

The first experimental paradigm (reception paradigm) for studying the evolution of concepts was developed by Hull in 1920. Stimuli, both then and today, are most often relatively simple visual figures in which the dimensions of variation are limited and controlled by the experimenter.

Stimuli are presented in succession, and typically there is not enough information available in any trial to allow solution of the problem. The subject must follow the events, by memory, over a series of trials, responding to each pattern by placing it in a category.

The subject gradually discovers (learns), through an inductive process based on the observation of a set of

positive and negative instances, some arbitrary scheme for grouping the stimuli. Information about the correct concept is acquired in bits and pieces on a trial-by-trial basis, until the subject can demonstrate that he knows the solution (Bourne, 1966).

There are two ways in which teaching painting styles differs from most experimental concept-formation tasks: the criteria that define the concept are difficult to identify because of the complexity of the stimuli; and it is not certain that such complex visual stimuli and the concepts they generate can be accurately translated into the verbal mode.

In considering the problem of differentiating the works of two painters on the basis of visual attributes, the visual (formal) complexity of the stimuli is immediately apparent. Stimulus attributes may also be compounded in novel ways that produce denotative meaning for the viewer. The term denotative meaning refers to associative concepts triggered by a complex stimulus such as a written word, which has a shape, a size, and a denotative meaning "dog" (Staats, 1968). With paintings, denotative meaning could occur both with respect to the subject matter and the viewer's aesthetic preference. Unlike Hull's stimuli, the critical attributes by which a viewer categorizes this kind of multi-faceted stimulus are usually completely confounded and inaccessible to the experimenter.

"A concept exists whenever two or more distinguishable objects or events have been grouped or classified together and set apart from other objects on the basis of some common feature or property characteristic of each" (Bourne, 1966, p. 1). Verbally labeling concepts is a useful way to distinguish among them although concept and label are theoretically separable entities.

Zimmerman and Rosenthal (1972a) have demonstrated that concepts can be taught by observational (modeling) procedures, although verbal rules facilitate generalization and also memory (Bergan, 1972). Daniel (in press) has shown, however, that labels may distort memory for shapes.

One of the instructor's difficulties in teaching art is an awareness that labels do not adequately describe concepts. It is generally agreed that a verbal label helps students to clarify, distinguish, and remember; but if the possibility exists that a concept may be based on mental imagery, then one may feel that verbalization sometimes reduces visual imagination. This could hinder or impoverish concept formation.

The possible role of imagery in concept formation (Arnheim, 1969; Paivio, 1971) makes it seem likely that concepts can exist without an equivalent verbal label (Pylyshyn, 1973). Evans (1967) has experimented with nonverbal (schematic) concept formation without feedback, and Cahoon (1970) found knowledge of results in a

concept-formation study to have a negligible effect on concept attainment, while it nevertheless improved subjects' ability to use information efficiently.

The Experiment

The present experiment compared a guessing-feedback condition with a verbal modeling condition, and compared the use of verbal rules with a non-rule (label-only) condition in teaching college students concepts of four painting styles. Color slides of paintings by French artists of the 19th century--Manet, Renoir, Degas, and Lautrec--formed the stimulus set. Learning (concept attainment) was measured by how confidently the students could discriminate the paintings of Renoir, Degas, and Lautrec from those of Manet, when confronted with works of all four artists that the students had not seen before.

Paintings provide excellent stimulus material because verbal criteria established by experts regarding style differences are available in the art history literature. There is an extensive body of verbal material describing the stylistic differences between one historical period and another, or one artist and another, or the works of a young artist and the same artist's work as a man of mature years.

In this experiment two kinds of art learning situations have been compared: an active condition (guessing followed by feedback) and a passive condition (verbal

modeling). Within each of these two conditions there were two different trainee-information levels.

In the first information-level condition, for every painting the subject saw he was given a label (artist's name) plus a rule for discriminating the attributes relevant to a concept of style. That is, a verbal label plus distinguishing verbal stylistic characteristics were presented for each stimulus picture. Within the second information level the subject was given a label only (artist's name).

The experiment was organized into a learning period; an immediate generalization task to assess concept acquisition; and delayed tests to examine training and concept retention, generalization, aesthetic preferences, and trainee-defined attributes relevant to style concepts.

Theory of Signal Detectability

Measures of group performance in this experiment had two components: (1) subjects' ability to deduce the concept, and (2) their willingness to guess whether a particular stimulus was an example of the concept. Subjects' willingness to make judgments under conditions of uncertainty is a problem that classical psychophysics has never handled well.

> The concepts of absolute and differential thresholds that are central ideas in the older theories have not given us a real grip on the performance or efficiency differences that can exist because of the differing criterion states of observers (Wheeler, 1973, p. 1).

Some people, because of particular learning histories, are more sensitive than others to stimulus features of art objects. The judgment of an observer of a work of art may be influenced by his social milieu, specific knowledge, visual aptitude, or a host of unspecified variables. An observer of a work of art can also express an aesthetic judgment in terms of a like-dislike opinion about it.

Subjects in the present study were required to make their responses in a classroom situation. All were college students and therefore had considerable previous experience in classrooms. Because of prior learning experiences, some were probably more willing than others to respond to the questions of the experimenter, even though all subjects knew there was no punishment involved (grading). The risk of being wrong, however, is not an easy one to take, in a learning situation in our culture.

The Theory of Signal Detectability (TSD) offers a recent and different approach to clarifying the measurement of task performance. A signal detection model developed at The University of Arizona (Wheeler, Daniel, Seeley, and Swindell, 1971) was used in this experiment to evaluate the effectiveness of the different instructional strategies. Recent investigations (Daniel, Wheeler, Boster, and Best, 1973; Seeley, 1973) indicated that a TSD analysis of art

learning situations could provide a more precise analysis than traditional methods.

TSD has three attributes that make it valuable for use in dealing with stimuli as complex as paintings.

First, observers are not required to verbalize in order to respond. This allows direct response to visual stimuli and a method of measuring nonverbal concept formation.

Second, stimulus variables do not have to be identified or controlled. TSD can in fact allow us to draw inferences about stimulus characteristics as a result of observer sensitivity.

Third, the TSD model distinguishes between observer sensitivity and willingness to respond (criterion state). Inasmuch as an individual's criterion (guessing bias) is based on many different things (feelings, problem-solving strategies, probabilities of occurrence) it is a source of variability. TSD reduces this variability and provides more exact experimental outcomes.

Experimental Hypotheses

Immediate Concept Generalization: Active-Passive

In a comparison of the active (guessing-feedback) and passive (verbal modeling) conditions, students learning under the passive procedures were expected to correctly

identify the style of Manet significantly more often during immediate concept generalization than students learning under the active procedures.

Levels of Information

Within both the active and passive strategies, high information (label-plus-rule) groups were expected to display significantly greater concept attainment on immediate generalization than low information groups (label-only). Label-only groups were expected to exhibit significantly more concept attainment than the control groups.

Active-Passive by Levels-of-Information Interaction

The different training procedures were expected to differentially affect performance of the four treatment groups. The passive label-plus-rule group (Group 5) was expected to perform significantly better than all other training groups.

Artists by Treatment Interaction

Training was expected to significantly affect how well subjects identified Manet, or how well they distinguished other artists as not-Manet. Group 5 (passive label-plus-rule) was expected to have significantly more success in correctly identifying Manet, and significantly more success in correctly identifying the other artists as not-Manet.

Concept Retention

Concepts acquired during training, and exhibited immediately afterwards on a generalization test, should still have a significant amount of strength after a delay of two weeks. Groups were expected to perform in a fashion that corresponded to the results of training, with some deterioration over the time span.

Delayed Generalization

Students who could generalize concepts immediately after training should be able to do so at significant levels two weeks after training, with perhaps some loss of concept strength. Passive groups were expected to predominate over active, high-information over low-information conditions.

Training Slide Retention

Training was expected to differentially affect performance on this retention test, since this is a delayed test of concept attainment. Subjects were expected to perform in a manner corresponding to the outcomes on the active-passive by levels-of-information interaction in the immediate generalization analysis. Group 5 (passive label-plus-rule) was expected to perform at a significantly higher level than other training groups.

Aesthetic Preference

It was anticipated that strength of preference would change significantly from group to group as a result of differences in training strategies. Subjects in all training groups were expected to prefer the target artist, because their attention was directed to him through the nature of the generalization and retention tests.

Elicited Relevant Attributes

Rules were expected to significantly inhibit the number of criteria generated spontaneously by a training group. Label-only groups were expected to spontaneously generate a significantly higher number of criteria than the label-plus-rule groups.

Conclusion

While many studies of the relative effectiveness of learning strategies have been performed in other fields, no study similar to the one proposed here has been found in the literature of art education. This experiment varies in two major ways from similar studies in other areas.

First, it uses highly complex visual stimuli. Second, the TSD method permits analysis of the performance data in terms of a stable index of actual learning (sensitivity) distinct from criterion states (guessing or other bias).

There is a philosophical gap that exists between people trained as working artists and those who consider themselves academicians in the traditional, verbal sense. There are many artists who teach at the university level and consider themselves a bona fide part of the academic world who believe quite firmly in the uselessness of words when it comes to describing either the process or product of art. Because it deals with nonverbal phenomena, this experiment should open avenues for needed research in this area.

CHAPTER 3

RELATED LITERATURE

Literature surveyed in this chapter that relates to the experiment comes from the areas of concept formation, imagery, social learning theory, experimental aesthetics, and the Theory of Signal Detectability (TSD) in that order. A brief description of TSD theory is included since this is a somewhat unusual feature of the study.

Concept Formation and Imagery

Bourne (1966) extensively covered the process of concept formation in his book, Human conceptual behavior. He considers experimental paradigms, theories of conceptual behavior, task variables (including factors of informative feedback, conceptual rules, and rule learning), and conditions that affect the performance of subjects, such as motivation, stimulus factors, and transfer of training. Attribute- and rule-learning aspects of conceptual behavior are treated by Bourne and Haygood (Haygood, 1972; Haygood and Bourne, 1965). Because such tasks also involve the ability to discriminate, Riley's (1968) work on discrimination learning has proved particularly pertinent.

Walk (Walk, 1967; Walk, Karusaitis, Lebowitz, and Falbo, 1971) has already identified the learning or painting

style as a concept-formation task. The instructional strategy Walk employed was, by his discription, a standard one used in courses in art appreciation. By using a pretest-training-posttest method, he demonstrated that subjects acquired a concept of style by viewing color slides of paintings.

During pretest, subjects tried to identify the artist as each slide was presented, but received no feedback. Training required subjects to guess the artist, after which the artist's name and title of painting (knowledge of results) was given. The posttest used twelve slides, six of which were from the pretest and six of which were new. Twenty-three per cent of the slides were correctly identified on the pretest. This rose to 43% on the posttest, indicating conceptual learning. Forty-five per cent of the slides not on the pretest were accurately identified.

Tighe (1968) verified Walk's findings using different artists and black and white slides. A greater number of training trials were used but Tighe noted that with few exceptions subjects were correct in their guesses on the fourth training trial, and many made correct guesses on the third presentation.

Verbal rules will positively influence perceptual learning. Bergan (1971) developed perceptual learning tasks to train children to assign verbal labels to distinctive features of letter shapes. Bergan found that verbal

pretraining such as labeling of positional cues or the learning of rules for letter formation from appropriate shapes facilitated perceptual learning.

A further study (Bergan, 1972) was designed to clarify whether facilitation occurred as a result of directing the children's attention toward distinctive features, or if instead the verbal labels helped the children to represent them in memory. Four training conditions were used: discrimination, motor representation, verbal representation, and reproduction. In the letter naming task lower case letters (p, q, b, and d) were used. Bergan surmised that the superiority of the verbal and motor representation groups over controls, discrimination, and reproduction supported the hypothesis that pretraining in attribute representation provided a way to remember stimuli to be subsequently identified. Daniel (in press) has found that verbal labels may have important effects on the kind of form that is remembered.

The recent emergence of imagery as an area of interest for psychologists, after the behaviorally-dominated period of the thirties and forties, has been described by Holt (1964). Paivio (1971) has accumulated a comprehensive documentation of the relationship of imagery to verbal processes. A symposium on imagery in children's learning appeared in the Psychological Bulletin in June, 1970 (Imagery in children's learning: A symposium, 1970).

Pylyshyn (1973) in a critique of mental imagery elaborates the theory of propositional knowledge as something that is true or false and which may be asserted by words ("the vase is on the table") but is not the same thing as the words themselves. Pylyshyn points out that concepts in such propositions may not correspond to available words in our language. "Such concepts . . . may be perceptually well defined without having any explicit natural language label. Thus we may have a concept corresponding to the equivalence class of certain sounds or visual patterns without an explicit verbal label for it" (p. 7).

Applicable work has been done by Evans and others at Texas Christian University on schematic concept formation (Evans 1967; Tracy and Evans, 1967; Brown, Walker, and Evans, 1969; Evans and Arnoult, 1967). Schematic concept formation is defined as the development of the ability to assign objects to appropriate schema families on the basis of information derived from perceiving the objects, without any other source of information concerning categorization (no knowledge of results) and without prior familiarization with the relevant schema.

In this context a schema is a set of rules, a characteristic of some population of objects. Schema theory proposes that humans abstract and use the redundant aspects of the environment to reduce information processing and storage requirements. In the assignment of objects to

classes there is, no doubt, a large amount of redundancy, and no single attribute need be a perfectly reliable contributor to the assignment process.

Evans contrasts schematic concept formation with didactic concepts, traditional concept formation tasks in which the experimenter conveys his previously determined categorization to the subject. Evans has found that attributes relevant to a stimulus category may be perceived without a label, and a label may or may not be attached.

Social Learning Theory

Gerst (1971) found that symbolic coding of modeling stimuli enhanced observational learning. Coding was defined as the process of forming summary labels which encompassed the essential element of the model's performance. Gerst reported a significant relationship between the retention of summary codes and delayed reproduction of modeled responses.

Rosenthal, Alford, and Rasp (1972) have studied concept attainment as a result of observation (modeling) in second graders. An imitation phase was used without extrinsic reinforcers (Bandura and Barab, 1971). Three kinds of information (weak verbal code, strong verbal code, strong code plus rule) were used to guide correct responses. High verbal code groups generally outperformed low-code groups, although providing a rule-summary appeared to create

interference on a delayed generalization task for the high code plus rule group.

Zimmerman and Rosenthal (1972a) applied a similar experiment to third graders to teach a dial-reading, numerical concept. Here concept learning was shown to have occurred as a result of modeling alone, although the response-rule groups display strongest performance on learning, transfer, and retention tests.

Rosenthal and Zimmerman (1972) demonstrated that children could learn conservation tasks in observational (modeling) learning situations. Rosenthal and Carroll (1972) taught economically disadvantaged seventh graders complex grammatical constructions (complex sentences containing the past perfect tense) by using modeling.

Zimmerman and Rosenthal (1972b) introduced a knowledge-of-results (feedback) dimension into an observational learning concept-formation experiment. They found that nonmodeling groups appeared to profit from feedback, while modeling groups did not. Vicarious procedures produced stronger results than the practice-plus-feedback approach. Zimmerman and Bell (1972) made a study of the influence of observer verbalization on vicarious rule learning. Their research indicates that in complex conceptual tasks an observer's verbal description of the model's behavior disrupted learning of an abstract rule.

Experimental Aesthetics

Style refers to the way in which something is said or done, as distinguished from its substance (Morris, 1970). Differing styles may be found among civilizations, historic periods, and artists.

Child (Child, 1965; Child and Sumiko, 1968) has evaluated aesthetic sensitivity by comparing a subject's artistic preferences or evaluations of artistic merit with the consensually established judgments of experts (e.g., artists, art critics, and art students).

Child's (1965) evidence indicated a lack of convergence between the judgments of expert and nonexpert groups. When the two criteria are not concordant, questions may be raised regarding the grounds for ascribing validity to expert opinion. The judgments of those who have had specialized training in art reflect intensive exposure to works of art and also exposure to attitudes that have for historical reasons become implanted in art schools (Berlyne, 1971).

From his research Child isolated five principal behavioral tendencies distinguishing those persons who are most similar to experts in their ratings of art reproductions: (1) tolerance of complex situations; (2) tolerance of ambiguity of feelings or perceptions; (3) "exploration" (scanning), breadth of attention, and the accuracy with which details of objects or events are noted; (4)

independence of judgment; (5) "regression in the service of the ego," i.e., a capacity to escape momentarily from the usual logical restraints of adulthood and take an interest in playful, imaginative, and unusual aspects of things (Berlyne, 1971).

Motivated by Child's research, Mirels and Efland (1970) attempted to appraise certain structural properties of aesthetic reactions. They presented a number of postcard-size reproductions of abstract paintings to subjects and asked them to "put together into groups the paintings that seem to belong together." Multi-dimensional scaling (MDS) analyses identified six dimensions underlying subjects' groupings related to colors, shapes, lines, textures, surface area, etc. Most of the paintings had high loadings (positive and/or negative) on more than one dimension. Mirels and Efland at the time of the preceding article were beginning a study in which subjects were to be required to rank order a series of paintings in terms of their similarity to a target painting, to see whether or not the mean rank orders obtained in this manner would approximate the MDS distances.

Eysenck (Eysenck, 1968; Eysenck and Castle, 1970) has experimentally studied aesthetic preference judgments using polygonal figures. Eysenck used Birkhoff's (1932) enumeration of elements which make up order and complexity in polygons (order: symmetry, equal sides, equal angles,

etc.; complexity: number of sides, re-entrant angles, etc.). Whereas Birkhoff felt that aesthetic pleasure was a direct function of the number of order elements, and an inverse function of the number of complexity elements, Eysenck found preference judgments to be the product of order and complexity elements, with the more complex figures being more liked. When Eysenck and Castle compared preference judgments for art students with preferences of non-art students, artists preferred simple polygons, non-artists complex ones.

There have been a few attempts to use multi-variate scaling procedures for classifying works of art. Choynowski (1967) had subjects rate 42 highly varied paintings on each of 46 7-point scales. Correlations between judgments on different scales revealed eight factors or dimensions, named as follows (with the scale possessing the highest loading within each factor mentioned for clarification): "artistic value" (banal-original), "interpretation" (false-genuine), "mood" (heavy-light), "composition" (chaotic-organized), "tonality" (cold-hot), "elaborateness" (sketchy-elaborate), "content" (devoid of content-full of content), "geometricity" (nongeometric-geometric).

Theory of Signal Detectability

Signal detection experiments in perception follow in a tradition of experiments on the absolute threshold, or

lower limit, of sensitivity. The attempt to measure the just noticeable difference between two stimuli is called the difference threshold, while the just noticeable stimulus is called the absolute threshold. "In current terminology, the absolute case is called 'detection' and the difference case is called 'recognition'; detection is the special case of recognition where one of the two stimuli to be discriminated is the null stimulus" (Swets, 1973, p. 991).

A detection experiment is one in which the presence or absence of some aspect of stimulation is indicated by the subject. The stimulus selected for detection may be a tone, flash of light, a pressure on the skin, or some more complex feature of patterned stimulation like a break in a Landolt ring. The discrimination may be complicated by presenting the signal in a noisy background, or under impoverished conditions such as low illumination or a high rate of speed (Gibson, 1969).

Stimulus intensity needed to exceed threshold will vary from trial to trial, however, even if constant stimuli are used. Perfectly uniform relationships between stimulus intensity and "yes, I see it" responses are rarely obtained. Signal detection models attribute much of this variability to the judgmental criterion level or decision criteria adopted by the subjects. The observed value of the threshold is a combined result of the sensitivity of the observer's

sensory system and his tendency to offer a "detection" judgment, that is, his judgment criterion.

The perceptual system is never quiet (Dember, 1960). As a consequence it is impossible to have a completely noise-free situation. Each observation of a perceiver will be made under one of two conditions: that which contains some signal-plus-noise, and that which contains noise alone. Because every signal is presented against a constantly changing background of noise, the perceptual effect of a physically constant signal will fluctuate from trial to trial.

Unless the signal is quite intense relative to the noise level, a perceiver desiring to detect any significant number of signals runs the risk of falsely "detecting (responding yes) some inputs containing only noise." The detection task for the observer, then, requires that he establish some criterion for judging that a signal is present. Generally, whenever the perceptual input on a given trial exceeds the observer's criterion value, he will respond yes (a signal is present), otherwise he will respond no (no signal is present).

The value of the observer's criterion depends on three factors: (1) the a priori probability of the occurrence of a signal, (2) the likelihood that the particular input on a given trial represents signal-plus-noise rather than noise

alone, and (3) the consequences (reward or punishment) of correct and incorrect decisions.

The probabilities and consequences influence each individual's report of his discrimination, and bias the outcome of any discrimination experiment by introducing variability. Measurements vary and become inconsistent, and the effects of biasing factors in reporting have often been viewed as properties of the discrimination process. As a result, incorrect conclusions have been drawn about the nature of perception and cognition (Swets, 1973).

Seeking measurement techniques to minimize the effects of bias has been a problem of psychophysics since the basic psychophysical methods were developed by Gustav Fechner in the nineteenth century. Swets, Tanner, and Birdsall (1964) have described the advantages of the Theory of Signal Detectability (TSD) in this context as follows:

> The particular feature of the theory that was of greatest interest to us was the promise that it held of solving an old problem in the field of psychophysics. This is the problem of controlling or specifying the criterion that the observer uses in making a perceptual judgment. The classic methods of psychophysics make effective provision for only a single free parameter, one that is associated with the sensitivity of the observer. They contain no analytical procedure for specifying independently the observer's criterion. These two aspects of performance are confounded, for example, in an experiment in which the dependent variable is the intensity of the stimulus that is required for a threshold response. The present theory provides a quantitative measure of the criterion. There is left, as a result, a relatively pure measure of sensitivity (p. 3).

TSD was developed during the early 1940's to assess operating characteristics of non-human receivers of auditory waveforms. The detection of signals in the presence of noise was considered to be similar to the problem of testing statistical hypotheses. In statistical theory there are two overlapping population distributions, H_0 (the null hypothesis) and H_1 (the alternative hypothesis). In the detection of electromagnetic signals, noise alone was identified with the null hypothesis (H_0) and noise plus a signal with the alternate hypothesis (H_1).

Ordinarily, in statistical theory, the probability of making a Type I error (accepting H_1 when H_0 is true) is fixed arbitrarily at .05 or .01, and then a criterion is chosen that will minimize a Type II error (accepting H_0 when H_1 is true). TSD, through the Receiver Operating Characteristic (ROC), gives the two types of errors equal status and shows how they covary as the criterion changes for any given difference between the means of the two hypotheses (Swets, 1973).

The detectability of the signal is specified by the separation between the alternative hypotheses. This separation or difference between the means is what is graphed on the Receiver Operating Characteristic. TSD developed largely around the analysis of the waveforms of signal and of noise. To simplify a very complicated problem, let us say that because of knowing the energy of

the signal, it was possible to determine mathematically the parameters of both the distribution of noise (N) variables and signal-plus-noise (SN) variables. These variables are normally distributed and have the same standard deviation. If the difference between the means of these two normal distributions is divided by their common standard deviation, this standardized difference expresses the detectability of a signal in noise. This index of detectability is called d', and is represented in Figure 1.

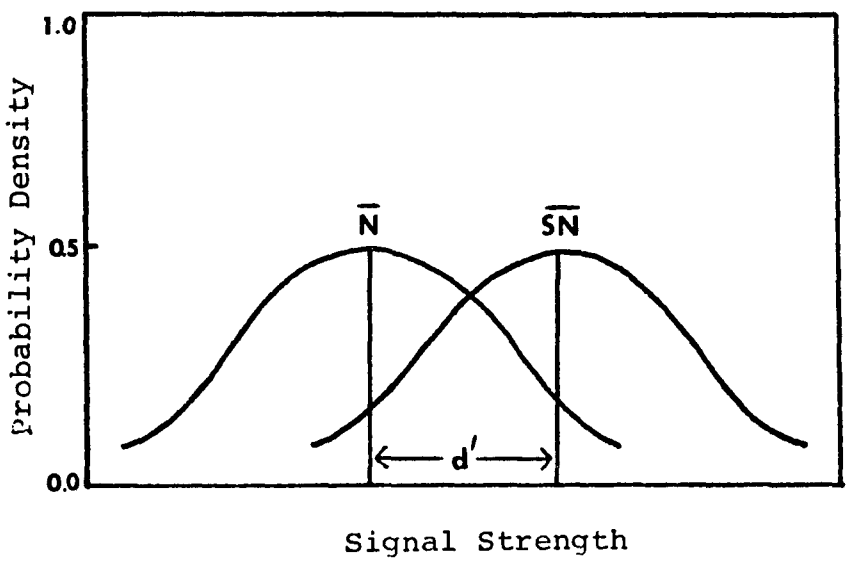


Figure 1. Sensitivity index d' as a function of signal strength: two distributions of likelihood ratio, one for noise alone and one for signal-plus-noise.

On each trial the observer responds yes or no on the basis of a likelihood ratio. If the likelihood of a signal being present exceeds his cutoff point or criterion, he responds with a yes. For each yes-no decision there are four possible outcomes. These are indicated in Figure 2.

	Signal-plus-noise	Noise alone
Yes	Hit	False Alarm
No	Miss	Correct Rejection

Figure 2. Decision outcomes for a two-stimulus (signal-plus-noise and noise) detection task.

For each value of the cutoff point or criterion there is a specific Hit Rate (HR) and a corresponding False Alarm Rate (FAR). These may be plotted on a graph and the result is called a Receiver Operating Characteristic. Each point on the graph represents a set of two cumulative probabilities, the likelihood-ratio criterion that describes the receiver's performance (Figure 3). The HR and FAR have been selected for descriptive purposes, frequencies in the Miss and Correct Rejection categories simply being the complements of these rates.

If signal energy is low, the distribution for the SN trials may coincide with that of the N trials and the

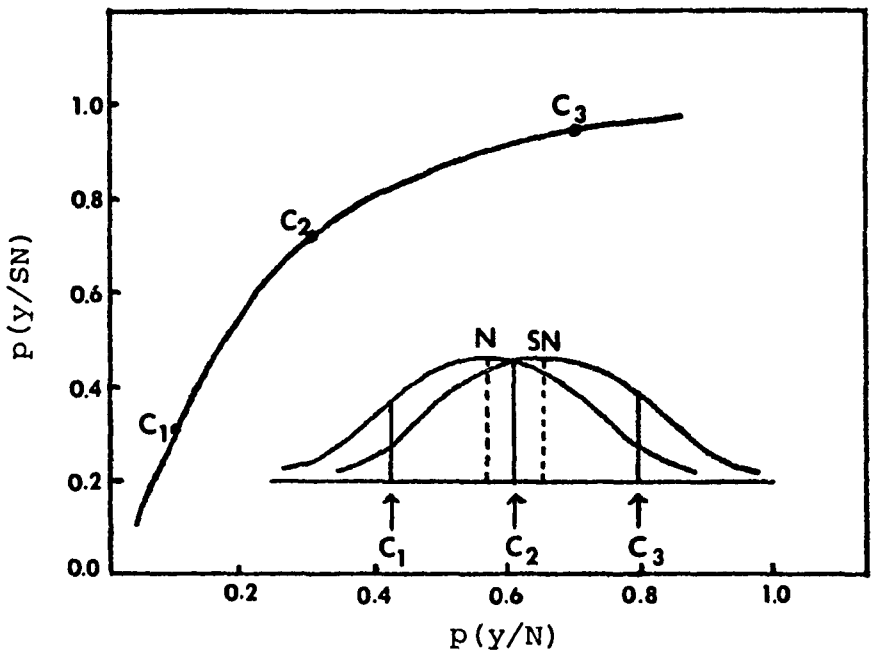


Figure 3. The process by which an ROC is generated by passing the cutoff C through two overlapping curves -- The value of d' is 1.0 (Egan and Clarke, 1966).

corresponding ROC will lie on the diagonal running from the lower left to the upper right-hand corner of the ROC graph. This diagonal is called the chance line. As energy increases the signal tends to become more and more detectable. The overlap of the two distributions will decrease and the value of d' will increase. If SN and N are easily discriminated from each other, the ROC line will deviate considerably from the chance line.

The detectability of the signal, however (as measured by d'), does not change as different criteria are adopted by the observer. A series of criterion levels are

reflected in the ROC for each value of d'. Only changes in signal strength produce changes in d'.

If the receiver ignores the stimuli and guesses --employs no likelihood ratio--the points describing his behavior will lie on the chance line.

If the receiver gives a response inappropriate to his own likelihood ratio, the point that describes his performance will lie below the chance line (i.e., saying yes when no is the "right" answer).

During a single series of observations the human observer is capable of adopting multiple criteria. As a result, a rating method of accumulating data has become the preferred TSD procedure. Rating requires a statement about the odds (likelihood) that a signal was presented.

Prior to the use of a TSD rating method, observers in a detection experiment were trained to respond (yes-no) using a specified criterion. Coordinates for one point on an ROC were estimated from one series of trials. Observers then adopted a different criterion for the next series, until enough observations at several criterion levels had been accumulated to plot an ROC function. Criterion states were manipulated by instructions to be strict, payoff matrices, and knowledge of a priori probabilities of signal occurrence. Because this method of accumulating data is tedious, opposing the natural inclination of human observers

to change their criteria, rating is more often used (Egan, Schulman, and Greenberg, 1959).

Related TSD Literature

One of the clearest descriptions of the Theory of Signal Detectability and its applications in psychophysics has been written by James P. Egan and Frank R. Clarke (Sidowski, 1966). These investigators have used the TSD methodology primarily for measurements of hearing and speech communication, but in the cited chapter they also describe its usefulness for visual detection problems. Quite recently Swets (1973) has traced historically the psychophysical problem of obtaining precise measures of discrimination. He describes the operating characteristic as defined in statistics, and shows how the ROC in a detection task gives a measure of discrimination that is independent of the location of the decision criterion, and is presumably uncontaminated by the processes, such as expectation and motivation, that affect the response. Swets et al. (1964) treat decision processes in perception, relative to the use of TSD, while Licklider (1964) discusses the application of signal detection to observations by human subjects. Green and Swets (1966) examine the usefulness of signal detection for psychophysics, and Atkinson (1963) devotes himself to the same area.

Although TSD as a statistical approach is relatively new to psychology, it has already been used in a variety of ways. Clark and Rubin (1969) use it to analyze threshold differences in psychiatric patients; Egan (1958) discusses recognition memory and the operating characteristic. Lockheart and Murdock (1970) employed TSD as a model of the decision process in memory. To test theories of recognition memory by experimental data, they applied TSD to obtain performance measures that separated memory and decision processes.

In 1910 Perky found that his subjects had difficulty distinguishing faint slide-projections of objects from the products of their imagination. Segal and Gordon (1968) turned this into a signal detection task. They manipulated subjects' expectancies and the brightness of projected stimuli under three conditions: a naive (Perky) condition; an informed condition, with subjects aware that slides might be projected while they were forming requested images; and a discrimination condition without imagery.

Segal and Gordon formed the hypothesis that a "miss" could be due to internal noise created by imagery, or to subjects' guessing strategy when they had been instructed to expect images. Results showed that brighter signals were more detectable, and guessing strategies varied considerably. When stimulus brightness was held constant and the effects of guessing strategy were removed, sensitivity

(d') was still affected by subjects' expectancies; d' was highest for the discrimination condition, lower for informed imagery, and lowest for the naive imagery condition. Segal and Gordon concluded that imaging activity interferes with perception by raising the level of internal noise. This study does appear to provide evidence that imagery and perception are continuous modes of experience (Paivio, 1971).

At The University of Arizona a number of investigators have used the Theory of Signal Detectability as a psychophysical research tool. Wheeler et al. (1971) used TSD to evaluate the effectiveness of image-retrieval procedures. Computer-generated stimuli (quadrigons) were systematically varied with respect to image quality to provide four levels of signal-to-noise ratio for each independent variable. The signal detection index of discriminability, d_m, was found to be a sensitive indicator of an observer's ability to distinguish signals from non-signals at all levels of image degrading.

Rasmussen (1973) has employed TSD in the analysis of averaged evoked potentials (AEP) obtained from electroencephalograms (recordings of voltage potentials of the brain). He studied cortical evoked potentials in conjunction with information retrieval from visual images.

For some time knowledge of results (KR) has been considered an effective technique for enhancing performance

(Ammons, 1956). Seeley (1973) used computer-generated quadrigons to test the effects of knowledge of results and familiarity in a detectability task. Seeley used two experimental groups (KR and NKR) and two control groups (pre-exposure and test-only). Subjects underwent either a practice phase (pre-exposure and NKR) or a training phase (KR), with a transfer phase immediately following. Use of TSD methodology indicated that increments in performance of the KR group could be interpreted as a shift in criterion or guessing strategy rather than an increase in sensitivity.

Concept attainment and knowledge of results have also produced ambiguous results in non-TSD situations (Cahoon, 1970). Cahoon measured concept attainment with a card-sorting task and found a significant improvement in performance with a decrease in KR frequency. The experimental group showed no significant difference in concept attainment performance, but did show a significant improvement in their ability to use information efficiently.

T. C. Daniel has applied TSD methodology to situations requiring preference judgments. Angus and Daniel (1973) considered TSD a useful way to evaluate consumer preferences for various ice cream products. In an ambiguous stimulus situation such as this, a change in criterion biases the comparisons of raw rating scores. By using a ten-point certainty-of-response scale and TSD analysis, perception was separated from judgment criteria.

Daniel et al. (1973) used the same approach to evaluate public preference regarding forest landscapes.

> Esthetic evaluation of a natural landscape may be viewed as a psychophysical task. An observer views a physical stimulus array and makes a perceptual judgment. The distinguishing features of landscape-evaluation situations, especially those involving esthetic judgment, are the great complexity of the stimulus array and the somewhat unusual nature of the response. The required judgment depends simultaneously upon the observer's perception of the specific stimulus array and upon his past experience and expectations regarding such arrays. . . . According to our model an esthetic judgment is the joint product of the perceptual effect of the environment display and the esthetic standards of the observer (p. 331).

Additional Literature

Several general books on vision have been helpful to the formulation of the experimental task: Burnham, Hanes, and Bartleson's (1963) work on color; Dodwell's (1970) Visual pattern recognition; Graham's (1966) Vision and visual perception. R. L. Gregory (1966, 1970) has two books that have been useful: Eye and brain and The intelligent eye. Haber (1969), LeGrand (1957, 1967), and Gibson (1949, 1966) also belong in this category.

Journal articles by Bornstein (1973) on color naming; by Harmon (1973) on detectability of faces under varying conditions of visual noise; and by Gombrich (1972) on visual images have been of general interest.

In the discipline known specifically as art education, McWhinnie (1970) has reviewed recent literature in

perception and cognition and discussed its implications for theory and research. Beittel (1973) has recently published a book suggesting alternatives for art education research.

Finally, important contributions to the project have come from the works of Allport (1955), Arnheim (1969), Berlyne (1971), Boring (1929, 1942), Gibson (1949, 1966), Gombrich (1960), Hebb (1949), and Neisser (1969), among others.

CHAPTER 4

EXPERIMENTAL METHOD

The experiment had three main parts: training, an immediate test of concept generalization, and several post-tests given after a two week delay. Posttesting covered five separate items: concept retention, delayed generalization, training slide recall, aesthetic preference, and elicited criteria or attributes relevant to a concept of style. The entire experiment was conducted on two different occasions, separated by a period of approximately two months.

Subjects

One hundred and forty male and female college students were assigned to training and control groups, twenty per group. All were non-art majors enrolled in eight classes for teaching visual art to elementary education majors. As a matter of expediency, a number of students from one class were frequently assigned to the same treatment group, although selection from the total class enrollment was made at random, and the treatment was assigned at random.

Subjects were screened to ensure that they had no previous art history training covering the nineteenth

century; to ensure that they had 20/20 corrected vision (by individual testing with the Snellen Letter eye chart); and to ensure that they had no gross color vision anomalies [by individual testing with the Ishihara (1971) color plates].

A constant ratio of males to females was not obtained. Most of the subjects were females and there is some indication that males and females may perform differently on this type of task (Archer, 1962). In a more recent study reported by Swets (1973), Barr-Brown and White (1971) used the ROC to assert equality of performance of males and females in recognition memory, even though they may differ with respect to response bias.

Stimuli

Stimuli were 80 color slides of paintings, 20 by each of four artists: Manet, Renoir, Degas, and Lautrec. Slides selected for use in the experiment were assigned at random to one of three sets, so that each set was composed of an equal number of slides of all four artists. The three sets were used in training (20), immediate generalization (40), and various posttests (20). Slides for the posttests were grouped as follows: The concept retention test was a group of 12 slides selected at random from the immediate generalization set. Delayed generalization was a group of 12 slides selected at random from the posttest

set. Training slide recall was a group of 12 slides randomly selected from the training set. The aesthetic preference test was composed of three groups of 8 slides each; a group of 8 slides was selected at random from each of the training, immediate generalization, and posttest sets. To elicit verbal criteria, one slide of each artist was shown, and these four slides were randomly selected from the immediate generalization set.

Presentation of test slides was by projection onto a screen for viewing by an entire group. Since the experiment was given at two different times, the average number of subjects viewing slides at one time was ten. Artists' signatures on the paintings were covered with masking tape. The slide projector was manually operated by the experimenter.

Slides in each section of the experiment (training, immediate generalization, concept retention, etc.) were presented one at a time in a sequence that was held constant for all experimental treatment groups. The order of slides within each sequence was random.

Exposure times were the same for all groups of subjects. From pilot testing a 15 second exposure for training slides was found to optimal, with a 10 second interval for all testing procedures. Pilot testing also revealed that three repetitions of the training-slide sequence produced measurable learning effects. After

seeing the set of training slides three times, subjects in the pilot study were able to report the correct artists' names with one hundred per cent accuracy.

The decision to use four artists was determined by the choice of signal detection model (Wheeler et al., 1971). Manet, Renoir, Degas, and Lautrec all painted during the latter two-thirds of the nineteenth century. To trained experts, the style of each is unique. To the naive observer many aspects of the paintings (wearing apparel, for example) give an appearance of similarity to the works by these four men.

In general, slides for the experiment were chosen according to the following criteria: (1) subject matters of similar kinds were selected from among the slides that represented each painter; (2) the total set of slides for a given painter was representative of his entire productive career, not just one portion of it; and (3) slides were of acceptable photographic quality (i.e., clear focus, adequate color balance, etc.).

Final selection of slides was on the basis of preliminary sorting by subjects. All slides in the University of Arizona Art Department slide library meeting the general qualifications listed above were sorted by subjects working individually. These subjects did not participate further in the experiment. Subjects knew neither the artists' names nor how many artists the total

group of slides represented. A detailed account of the sorting procedures is included in Appendix H.

After sorting it was clear that Manet and Lautrec formed the extremes of a continuum, and that subjects rather easily confused Renoir and Degas. Manet was designated the signal-plus-noise and Renoir, Degas, and Lautrec were considered as noise alone. The slides were then manipulated according to the results of sorting, in an attempt to achieve three noise distributions at regularly increasing intervals from the signal-plus-noise.

It is possible to illustrate this graphically by means of a set of hypothetical probability-density distributions, one for the work of each artist in this experiment (Figure 4).

The axis labeled "Observer Confidence . . ." represents the observer's certainty-of-response that a given painting was, or was not, the work of Manet, the signal-plus-noise. The perceived distance between these hypothetical distributions increase in regular increments, and according to Figure 4 it is highly unlikely that a painting by Lautrec would be considered a Manet, just as there is a relatively strong probability that a Renoir would be considered a Manet.

In this experiment signal strength relative to noise is unknown. Paintings are visually complex and stimulus properties, in the sense of attributes relevant to concept

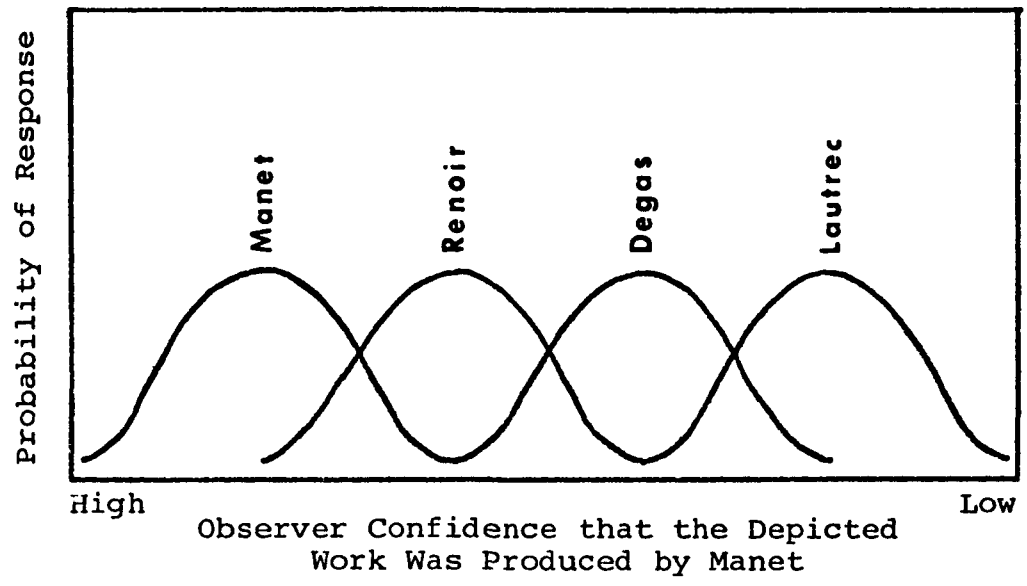


Figure 4. Four hypothetical distributions of likelihood ratio for the artists used in this experiment: one for signal-plus-noise and three for noise alone.

formation, are not well understood. Paintings are, however, well suited to a signal-noise kind of presentation. In such perceptual judgments some ambiguity results from the fact that the work of any one artist undergoes stylistic change, as a maturational effect, over the span of his productive years. Any initial concept of style may be too narrow to include all of one artist's work, or the concept may produce confusion between the works of two artists working from the same cultural milieu. The observer will always have some uncertainty about the work being identified.

When test slides were chosen an attempt was made to spread them evenly along the hypothetical stylistic dimension constructed in Figure 1, in uniformly overlapping distributions. Because the TSD method provides a stable measure of distance between the signal and any noise distribution, observer responses can be used to provide previously unknown information about the stimuli. The experiment has shown that the positions of the four artists along a continuum hold the same relative order as originally intended, but the overlap of distributions is much more uneven. Actual results in this regard can be observed in the graphs of cumulative probabilities in Appendix B, or in the graphs of ROC functions in Appendix E.

Experimental Groups

There were two levels of two training factors in this design, yielding four training groups, and in addition there were two control groups.

The factor called active-passive compared a guessing followed by feedback (knowledge of results) condition to a no-feedback or verbal modeling format. Subjects in the active condition were required to view the slide and to write the artist's name on an answer sheet, after which they were given the label or label/rule by the experimenter. Active control subjects were asked to write the artist's name in connection with each slide, but received no verbal

information. Passive subjects simply received label or rule information as the slide appeared on the screen. Subjects in the passive control group viewed the slides, made no response, and received no information. Labels and rules were spoken by the experimenter.

Within each active or passive group, one of three levels of information was given to each subject. Those in the label-plus-rule (high-information) condition heard the artist's name mentioned in connection with the stimulus, as well as a brief phrase verbally characterizing his style. Subjects in the label-only (low information) condition heard only the artist's name recited as each slide appeared on the screen. In the control condition subjects were exposed to the slides but were provided no verbal information, neither label nor rule.

Training Procedures

All subjects were told that they were participating in an art learning experiment to find out which kind of learning procedure is the most efficient. They were informed that during the learning phase they would see a series of twenty slides of paintings, painted by four different artists. Subjects were told that the painters' names were Manet, Renoir, Degas, and Lautrec, and that there were five paintings by each artist. They knew that following the learning period they would be required to identify

slides by these same four artists, slides that they had not seen before. Each subject received a printed set of training instructions, and the instructions were also read aloud to the entire group of subjects by the experimenter. A complete set of all training instructions and answer sheets is available in Appendix F.

Active Condition

Subjects were given, in addition to printed training instructions, an answer sheet containing numbers corresponding to the training slides. As each slide appeared on screen, subjects wrote the name of the artist who painted the picture beside the appropriate number, after which the experimenter told the group the correct name (and rule if appropriate). To avoid numbering errors, as each slide appeared on the screen the experimenter announced, "This is slide number one, . . . number two, . . . number three," etc., and did this for passive groups as well.

Passive Condition

Subjects received no answer sheet. The experimenter gave the label or label/rule simultaneously with presentation of the slide, but subjects were not asked to make any response.

Label-Plus-Rule Condition

Subjects received the artist's name (spoken by the experimenter) and in addition a short verbal characterization of his painting style. The rules were compiled from authoritative art history survey texts and are presented in full in Appendix G with the material on elicited criteria.

Label-Only Condition

Verbal information presented to subjects was simply the artist's name.

Control Condition

Subjects received all instructions prior to viewing slides and were exposed to stimuli for time periods identical to training groups, but were given no label or rule at any time. Active controls received answer sheets and were instructed to guess the artist's name, although they received no feedback.

Testing Procedures

The artist Manet was designated signal-plus-noise for all tests using TSD data-collection procedures. These were immediate concept generalization, concept retention, delayed generalization, and aesthetic preference. A ten-point certainty-of-response rating scale was used to collect data, a format modified from the scale used by Wheeler et al. (1971).

Subjects were provided with answer sheets, at the top of which were printed instructions for using the scale. Subjects were instructed to look for the work of Manet, and to respond on the basis of how confident they felt that a slide either was, or was not, Manet's work. The rating scale was printed on the answer sheet with a definition of each criterion ("0 - I am absolutely certain that this is not the work of Manet." Absolutely certain, yes - 9; absolutely certain, no - 0). Subjects were instructed to write the number for each slide that most nearly expressed how confident they felt that the slide either was, or was not, Manet's work. In the case of the aesthetic preference test, the scale represented a continuum from absolute liking to absolute disliking. Copies of all rating scales may be found in Appendix F.

Immediate Concept Generalization

Immediately after training, all subjects were given a generalization test. All subjects used answer sheets on which was printed a certainty-of-response scale, and were required to respond to each stimulus by writing a number from the rating scale in the appropriate blank on the answer sheet. Forty slides (10 of each artist) that had not previously been seen by subjects were presented in random order. Exposure time was ten seconds per slide.

Concept Retention and Delayed Generalization

All posttests were given at the same time, two weeks after the immediate generalization test, without prior notice to subjects. As a result, the number of subjects per experimental group varied from twenty to thirteen.

All subjects used answer sheets for concept retention and delayed generalization that were identical to the ones used for immediate generalization, and followed the same procedure of responding to each slide by writing a number from the rating scale. The 12 slides used to assess retention and the 12 slides used to test delayed generalization were combined in random order and presented as a single group of 24 slides. Exposure time was ten seconds per slide.

Training Slide Recall

This check was made to see how well subjects remembered the slides used in training. Subjects were given an answer sheet numbered from 1 to 12. They were shown 12 of the training slides (4 of each artist) selected at random from the original group of 20, each presented for ten seconds in random sequence. As each slide appeared on the screen, subjects attempted to identify it by writing the name of the artist who painted the picture.

Aesthetic Preference

The aesthetic preference test was also given two weeks after immediate generalization. All subjects used answer sheets on which was printed a rating scale modified to allow a choice on a like-dislike dimension, but identical in all other respects to those used for immediate generalization and retention. The 8 slides from each of three sets (training, immediate generalization, and posttest) were combined in random sequence and presented as a group of 24 slides. Subjects were not instructed to look for Manet, but instead were asked to respond to each slide on the basis of how much they liked or disliked it.

Relevant Attributes

At this same time (two weeks after immediate generalization) an attempt was made to elicit from subjects the criteria, expressed in their own words, that they had used in style discrimination. This was an effort to identify attributes relevant to the formation of concepts of painting style. Four slides (one of each artist, selected at random from the immediate generalization set) were presented for 60 seconds each. They were presented in the sequence: Manet, Renoir, Degas, and Lautrec. As each slide appeared, the experimenter asked subjects to write down why it looked like Manet (Renoir, Degas, Lautrec). A separate answer sheet

was provided for this purpose. An example of each answer sheet referred to in this section is included in Appendix F.

CHAPTER 5

RESULTS

Data from the immediate concept generalization, delayed retention and generalization, and aesthetic preference tests were analyzed according to the TSD model used Wheeler et al. (1971) discussed in Chapter 3. Two separate analyses of variance were performed, one using mean certainty-of-response ratings and one using the signal detection statistic $\underline{d_m}$, for all data collected with the ten-point rating scale. Significant differences between group means were determined by applying the Newman-Keuls post hoc test (Harter, 1960).

Training slide recall data were treated by a two-factor analysis of variance design based on correct answer scores. Elicited relevant attributes (regardless of content) were counted for each training group, and the total number generated were analyzed by a two-factor anova in the same fashion as training recall data. Summary tables for all analyses of variance and tables for Newman-Keuls post hoc analyses have been collected to form Appendix A.

Differences Between Mean Ratings and d_m Measures

The value of using signal detection in this particular study is that this method affords two distinct measures of the effects under consideration.

Mean Ratings

The most usual approach, in order to observe the results of the training program is to tally the ratings given by each subject to each stimulus. Means are then arrived at for each artist, each group, each subject, and so on, depending upon the given area of interest. This provides a straightforward index of subjects' tendencies to rate each painting as representing or not representing the target artist.

By using a ten point rating scale, the index is made more sensitive than a simple, two-point, yes-no type of response. In the present experiment certainty-of-response ratings have been utilized in each area for which data were available, and an anlysis of variance was conducted. Where applicable, a Newman-Keuls post hoc test was used to determine significant differences between specific training and control groups.

The d_m Index

Early signal detection research demonstrated the stability of the detectability index d', and showed that it

is not affected by changes in subjective criteria or by methodology. In these early experiments d' was determined under conditions that allowed for objective measurement of signal and noise energy characteristics, and specified likelihood ratio decision criteria.

Because the stability of d' has now been verified, the process can be reversed with unspecified stimulus variables; d' is obtained from a z transformation of ROC values, and the latter are generated by computing cumulative response probabilities from the most stringent through least stringent criterion states. The assumption is that if a response under the strictest criterion indicates that a signal was present, then signal-present responses would also have been made under less strict criteria.

The index of detectability, d', is computed from the ROC, and represents observer sensitivity, which is directly related to signal strength. The greater the distance of the ROC from the chance line, the greater the detectability of the stimulus. By obtaining d' from ROC values, we can estimate the parameters of the two stimulus distributions (signal-plus-noise and noise) even when their underlying perceptual characteristics are unknown.

Although d' has consistently been presented in this paper as the index of detectability, there are several other distance parameters (d_s, d_i, d_m). A clear description of their relative characteristics is available in Wheeler et al.

(1971). The distance parameter used in this experiment is d_m. It is the easiest of the four to compute, since it is the distance between the means of the Hit Rate (HR) and False Alarm Rate (FAR) z values.

$$d_m = M_z \text{ HR} - M_z \text{ FAR}$$

Wheeler et al. believe that d_m reflects actual observations better than do the other measures, since d_m is the average distance between all obtained points on the ROC and the positive diagonal or chance line.

The d_m statistic is computed from the cumulative frequencies of rating responses given by subjects. In the signal detection model, responses are accumulated from high to low ratings, or from certainty to uncertainty, rather than in the traditional low to high manner. These cumulative frequencies, converted to cumulative probabilities, are transformed to standardized z-scores from which d_m, or the distance between the means of signal-plus-noise and noise distributions, is derived.

The index d_m is a measure, not of how well subjects can identify the target stimulus per se (as in mean ratings) but rather of how well they can distinguish all other artists from the target. The d_m tables give figures only for non-target artists, since response data for the target artist (Manet) provide an origin, or baseline, for the differences and, thus, assume the value zero.

The statistic $\underline{d_m}$ is an estimate of the parameter d_μ and has a known sampling distribution, possessing properties that make it available for statistical analysis (Daniel, 1971). Analysis of variance, post hoc testing, and all analytical procedures described above in connection with mean ratings, may also be applied to the $\underline{d_m}$ sampling distributions.

First and Second TSD Analyses

When data for this experiment were collected, the analysis of variance run on the data employed a traditional TSD model. When subjects' ratings were compiled, they were grouped not by subject but by stimulus. Means were obtained in each group from all subjects' responses to each slide, and cumulative probabilities, $\underline{d_m}$ statistics, and so forth were derived in this manner. A good deal of information became available about individual stimuli, but not about individual subjects. The question naturally arose whether, in an experiment to measure learning in a group of individuals, TSD could be expected to give an accurate reflection of the outcomes.

In certain experiments conducted in the Psychology Department at The University of Arizona (Daniel et al., 1973) there seemed to be discrepancies in results due to the grouping of subjects in this manner. Daniel developed a new program that sums responses across stimuli and groups them

by individual observers. As in the previous model, responses to signal-plus-noise and noise are listed separately.

Data from this style-concept learning experiment were re-grouped according to Daniel's program and the two procedures compared by performing a second, simpler analysis of variance on the re-grouped data. Mean responses to each artist were obtained for every subject and this sampling distribution was analyzed. A corresponding $\underline{d_m}$ analysis was also made.

There were almost no numerical differences between the first and second analyses. Subjects used for Analysis 1 were not identical to those used for Analysis 2 as a result of the procedure used to reduce the number of subjects in the concept retention, delayed generalization, and aesthetic preference tests. Despite this difference, the results are virtually the same in mean ratings, and even more similar in the $\underline{d_m}$ measure. A comparison of actual numerical values, as well as comparisons of F-ratios, may be seen in Appendix A.

Insofar as it is possible to compare main effects and interactions, results are consistent in terms of significant F-ratios. Any comparison of Analyses 1 and 2 is approximate due to a difference in complexity. Analysis 1 incorporates all of the factors of the full TSD program, and as a result yields more information than the second. Analysis 2 was inaugurated as a checking procedure and was

constructed in a form in which it was easy to apply a Newman-Keuls post hoc test to ascertain significant differences between group means.

The factors in the first analysis are as follows: A = Artists, B = Slides, C = Subjects (mean ratings analysis) or Certainty-of-Response Levels ($\underline{d}_m$ analysis), D = Levels of Information (Label, Label-Plus-Rule, Control), E = Active-passive (Feedback, No Feedback).

The factors in the second analysis are considerably reduced: A = Artists, B = Subjects, C = Treatments. Both are completely randomized mixed designs. Complete source tables may be found in Appendix A.

Analyses of Variance for Posttests

The number of participants in the training and transfer sessions was held constant at twenty for each of the six groups. Since the posttesting was not announced prior to its being given, natural attrition caused the six treatment groups to contain, at the end of two weeks, unequal numbers of subjects ranging from twenty to thirteen. In order to carry out an analysis of variance using mean rating statistics all groups were reduced to thirteen.

Subjects were withdrawn from the groups at random until each numbered thirteen, upon the assumption that the attrition process was a random one. To test this hypothesis, the random selection procedure was repeated four times for

both concept retention and delayed generalization (combined data) and aesthetic preference. Analyses of variance provided F-ratios for each new configuration and the four examples were compared (Appendix A). Differences were slight enough to affirm that random elimination gave an unbiased appraisal of the factors in these studies.

Combined data from concept retention and delayed generalization were subdivided into concept retention data and delayed generalization data, to compare the effects of viewing old or new slides. Because the number of stimuli was small (twelve slides in each category), data were examined by means of d_m analysis only, as being the more accurate instrument for such a small number.

Graphs Based on Traditional Cumulative Probabilities

While the d_m statistic is based on frequencies accumulated from high to low, frequencies accumulated in the traditional manner (low to high) and converted to cumulative probabilities may be used to produce graphs that approximate a d_m distribution. Graphs of traditional cumulative probabilities provide a visual appraisal of the differences in detectability between all four artists used in the experiment, and in a general way the performance of different groups may be compared. Tables from which these graphs were prepared are located in Appendix B, and the graphs themselves form Appendix C.

ROC Functions

Graphs representing the signal detection approach to the data have a unique terminology dating from its communications origins, and describe Receiver Operating Characteristics (ROC). In signal detection theory, the ROC is a function of an observer's certainty-of-response rating (decision criterion) that represents the relationship between the Hit Rate (HR) and the False Alarm Rate (FAR). The HR is plotted on the vertical axis and the FAR on the horizontal axis, with one set of coordinates for each level on the certainty-of-response scale. The plotted HR figures are TSD cumulative probabilities of response for the signal stimulus. Each nonsignal stimulus has its own set of FAR cumulative probabilities providing, in this experiment, three d_m values for each ROC. When, as a result of training, subjects are able to distinguish between stimuli, the scores will differ from random behavior and the arc plotted on an ROC graph will deviate from the chance line; the more effective the discrimination, the greater this deviation will be. Appendix E contains ROC graphs for each treatment group in all of the TSD tests (immediate generalization, combined concept retention and delayed generalization, aesthetic preference), while Appendix D is the set of tables from which these graphs were drawn.

Order of Results

Results are organized according to the following outline:

1. Immediate concept-generalization data
    a. between-groups variables
        levels of information
        active and passive
        levels-of-information by active-passive interaction
    b. within-groups variables
        artists
        artists by levels-of-information interaction
        artists by active-passive interaction
        artists by treatments interaction
        slides
2. Concept retention and delayed generalization (combined data)
    a. between-groups variables
    b. within-groups variables
3. Training slide recall
4. Aesthetic preference
    a. between-groups variables
    b. within-groups variables
5. Elicited relevant attributes

Response measures based on ratings and the signal detection index d_m will be presented in that order for each effect.

Immediate Concept-Generalization Data

Levels of Information: Mean Ratings Analysis

The three types of information received by subjects (label-only, label-plus-rule, and control or no information) significantly ($p < .001$) affected response frequencies over the entire certainty-of-response scale. A Newman-Keuls post hoc test revealed that both information conditions varied significantly from the no-information condition (control), but label-plus-rule did not differ significantly from label-only. Figure 5 describes the performance of the three levels of information in terms of traditional cumulative frequencies of response.

Figure 6 gives average certainty-of-response ratings from the immediate generalization test as a function of levels of information. This graph charts responses from the first and second data collections, separately, to indicate the similarity of results, and provides a rationale for considering all of the data as one experiment. The first and second presentations of the immediate generalization test gave virtually identical results, despite considerable changes in the number of subjects in each group.

Levels of Information: d_m Analysis

The levels-of-information factor was significant ($p < .001$) by d_m analysis. Post hoc testing revealed that

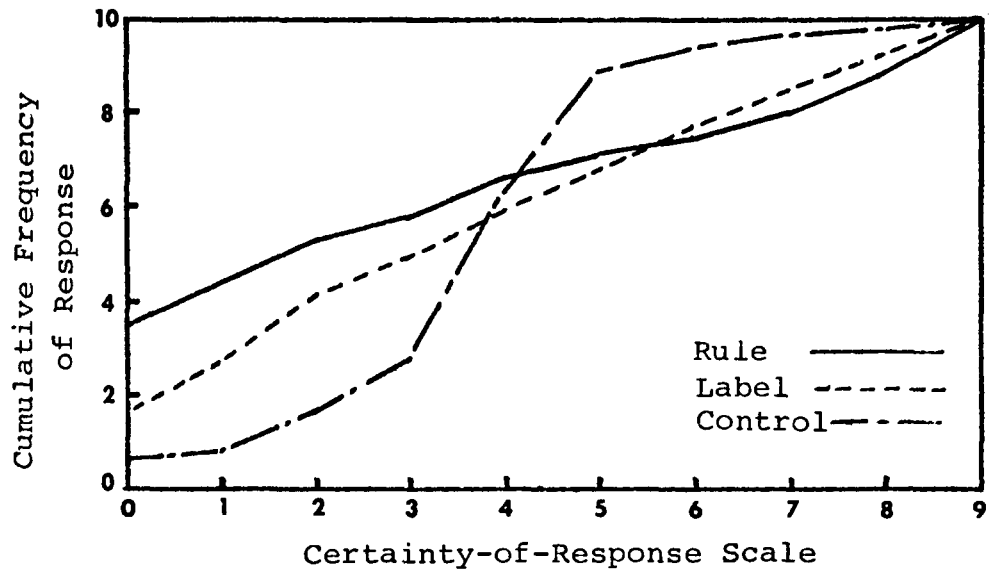


Figure 5. Immediate concept generalization: averaged cumulative frequency of certainty-scale responses; levels of information summed across active-passive and artists.

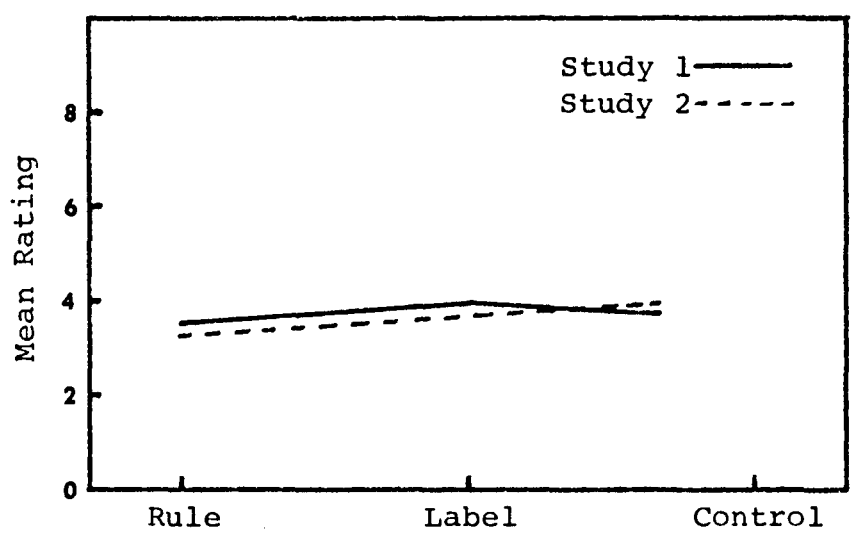


Figure 6. Comparison of first and second data collections: mean certainty rating as a function of levels of information.

performances of both label-plus-rule and label-only conditions were significantly different from control groups, and that label-plus-rule performed at a significantly higher level than label-only. By using $\underline{d_m}$ we can describe the effects of the three information levels relative to discrimination of all other artists from Manet. The index of distinguishability is the distance of any given group from zero, whether positive or negative. While similar results from the two testings are confirmed by both sets of statistics (mean ratings and $\underline{d_m}$), $\underline{d_m}$ demonstrates superior sensitivity. The difference in performance between training and control groups can more clearly be seen in the $\underline{d_m}$ statistics. This distinction proved to have great value in the test given after a two week delay, when a mean ratings analysis of variance produced a non-significant F-ratio and $\underline{d_m}$ a significant one for this factor.

Active-Passive: Mean
Ratings Analysis

The active (guessing-feedback) and passive (verbal modeling) factor was significant ($p < .001$) in immediate generalization analysis. Figure 7 plots the differences in means for the active and passive groups; means for the active condition were higher than those for the passive condition.

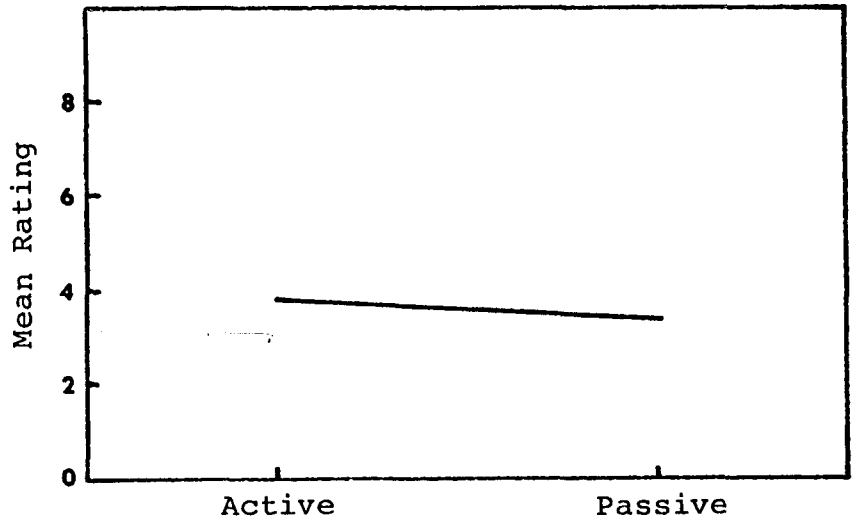


Figure 7. Immediate concept generalization: mean certainty-of-response ratings for active and passive conditions, summed across levels of information and artists.

Active-Passive:
d_m Analysis

The active-passive factor in immediate generalization was significant ($p < .005$) by d_m analysis. Figure 8 graphs the d_m values for the active and passive conditions, and it is apparent that the passive condition produced considerably more sensitivity to style differences than did the active.

Levels of Information by Active-Passive Interaction: d_m Analysis

In immediate concept generalization the mean certainty ratings do not show significance when examined by

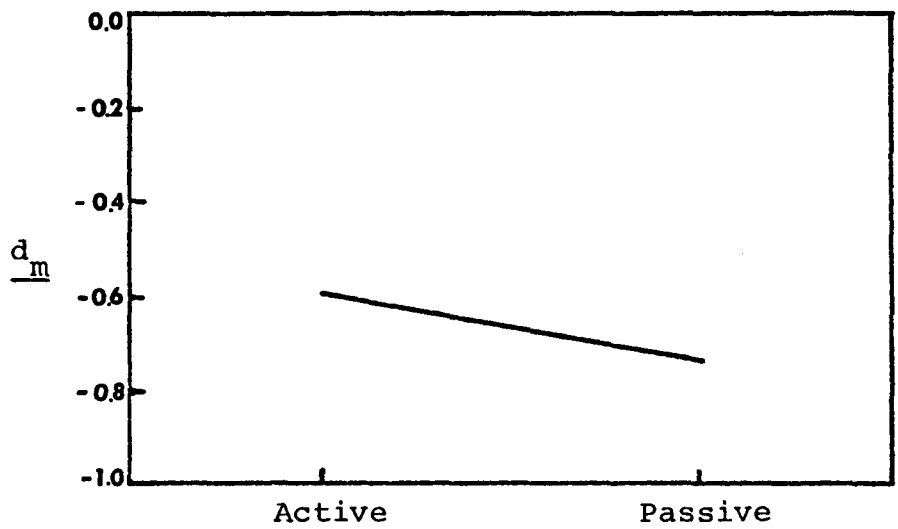


Figure 8. Immediate concept generalization: d_m for active and passive conditions, summed across levels of information and artists.

an analysis of variance. The signal detection index, d_m, shows this interaction significant at the $p < .001$ level. Post hoc comparisons of means indicated that all four training groups were significantly different from the two control groups, and that Group 5 (passive label-plus-rule) performed significantly better than all other training groups.

In Figure 9 we observe that the performance of controls was near chance levels, while the group that displayed strongest discrimination was Group 5 (passive label-plus-rule). The passive condition produced significantly

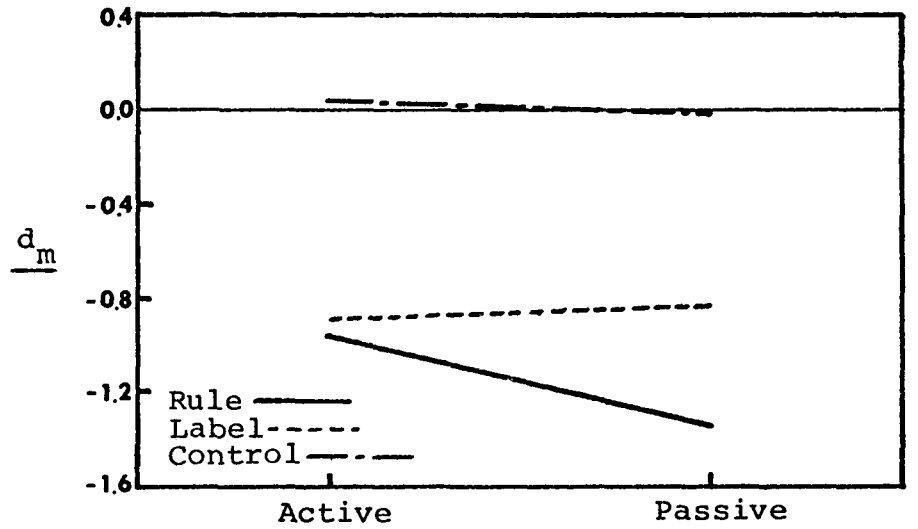


Figure 9. Immediate concept generalization: d_m for levels of information as a function of active-passive conditions, summed over artists.

stronger performance for the label-plus-rule (high-information) group.

Artists: Mean Ratings Analysis

The artists variable in immediate concept generalization is significant at the $p < .001$ level. Figure 10 shows that artists systematically affected response frequencies over the entire certainty-of-response scale. According to post hoc analysis, Renoir and Degas are not significantly different from each other, while the distance from Manet to Renoir-Degas is significant, and the distance from Renoir-Degas to Lautrec is significant.

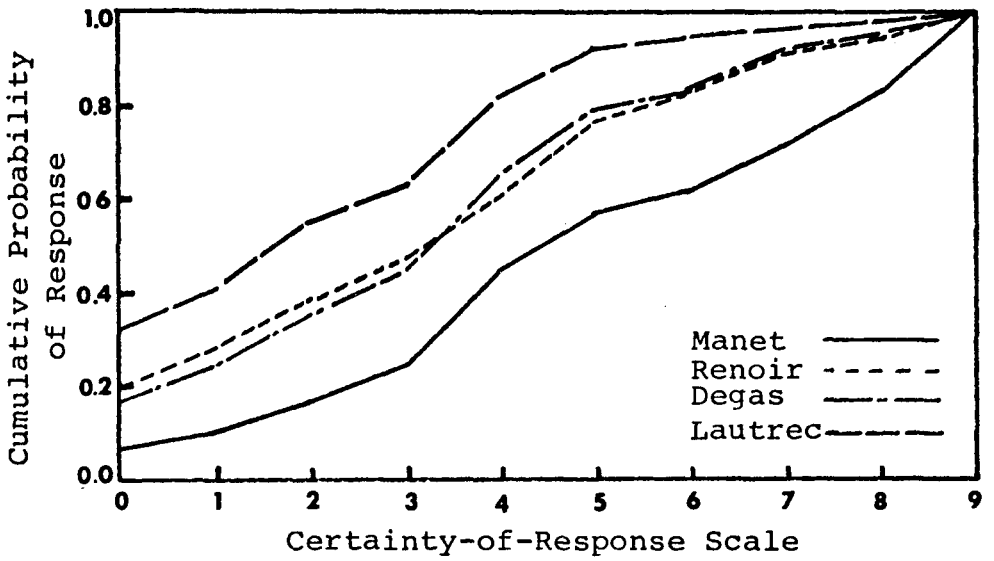


Figure 10. Immediate concept generalization: cumulative probability of certainty-scale responses; artists summed across levels of information and active-passive conditions.

Artists: $\underline{d_m}$ Analysis

The artists variable is also significant at $p < .001$ according to $\underline{d_m}$ analysis. Newman-Keuls testing revealed that subjects distinguished both Renoir and Degas as significantly distinct from Manet to about the same degree, while Lautrec was discriminated significantly better from Manet than the Renoir-Degas combination.

Artists by Levels of Information Interaction: Mean Ratings Analysis

A significant interaction ($p < .001$) was observed between artists and levels of information. Post hoc analysis revealed that while both label and label-plus-rule

conditions discriminated significantly between artists, the control condition did not. The only significant difference for a particular artist between the label and label-rule conditions was for Renoir, label-rule groups ranking him significantly lower than did the label-only condition. Figure 11 plots mean certainty-of-response ratings as functions of artists. The means of the two middle artists, Renoir and Degas, are similar in all groups, and these averages are like the means of all four artists in the control groups.

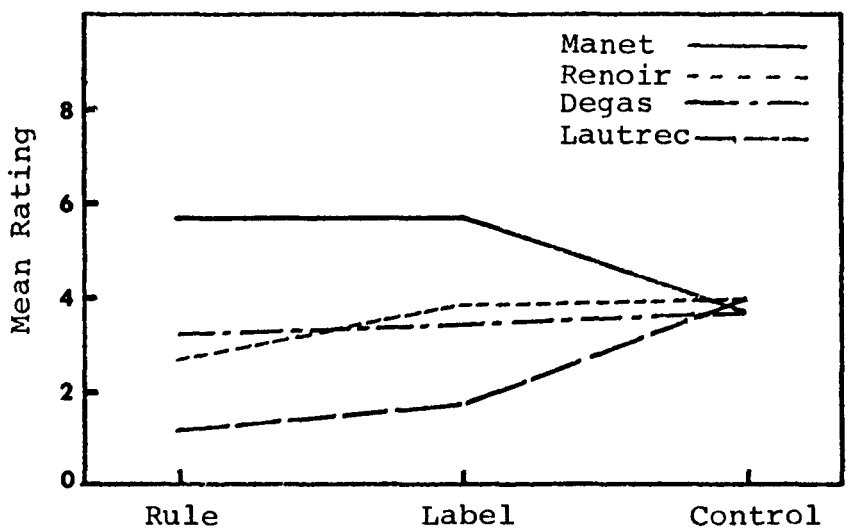


Figure 11. Immediate concept generalization: mean certainty-of-response ratings for artists as functions of levels of information.

Artists by Levels of Information Interaction: d_m Analysis

The interaction was also significant at $p < .001$ according to d_m analysis. Both information conditions discriminated all three noise artists from Manet significantly better than controls. Label-plus-rule discriminated Renoir from Manet significantly better than label-only did, according to post hoc testing. Figure 12 is a graph of d_m values for artists as functions of levels of information. In both Figures 11 and 12 we can see that label-plus-rule groups perceived Degas as more similar in style to Manet than they perceived Renoir to be, while label-only saw them both as relatively close to Manet in style, almost equally so. Figure 12 makes it easier to see the separation between training and control groups, whose means hover near the chance line.

Artists by Active-Passive Interaction: Mean Ratings Analysis

A significant interaction was observed ($p < .05$) between artists and the active-passive condition in immediate generalization data. According to post hoc tests, differences between artists were significant and correspond to those reported for the artists factor. There were no significant differences between the active and passive conditions for any artist. If cumulative probabilities of response are graphed for artists as functions of the active

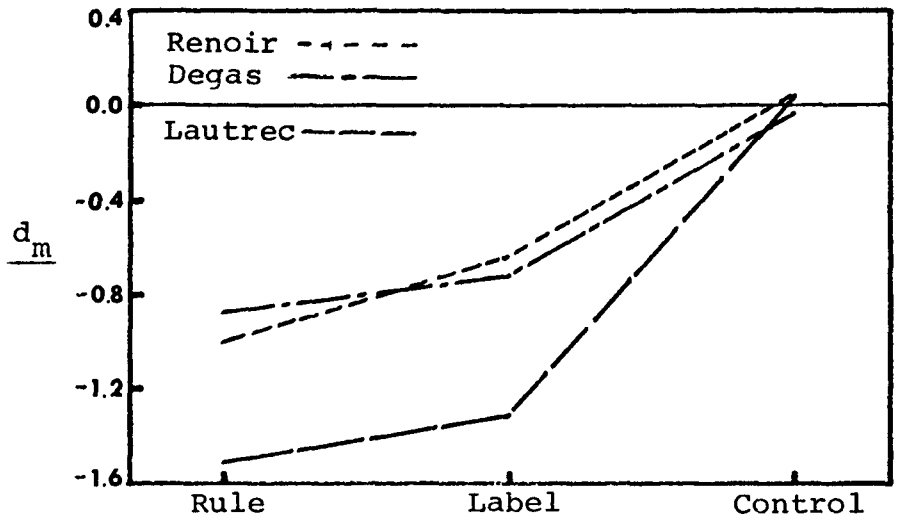


Figure 12. Immediate concept generalization: signal-detection index, d_m, for artists as functions of levels of information.

and passive conditions (Figures 13 and 14) it can be seen that the active and passive conditions made a clear discrimination between Manet and Lautrec, although the styles of Renoir and Degas were judged equally distant from Manet. This interaction was nonsignificant by d_m analysis.

Analysis 2, Artists by Treatments Interaction: Mean Ratings Analysis

A significant interaction between artists and treatments was observed with re-grouped data ($p < .001$). Post hoc analysis of mean ratings showed considerable variation in significant differences as functions of artists. In general, training groups were significantly better than control groups, but patterns were erratic. With respect to

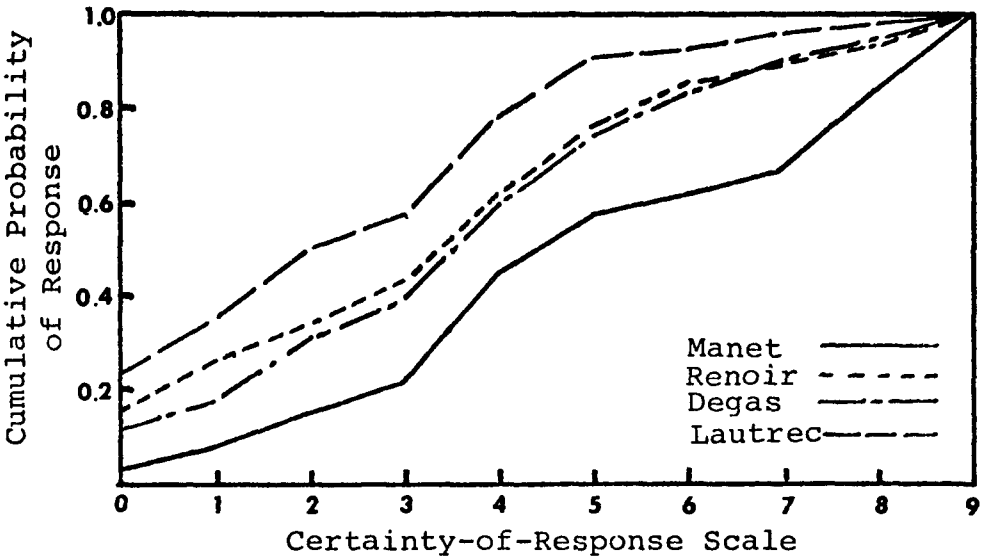


Figure 13. Immediate concept generalization: cumulative probability of certainty scale responses; active responses to artists, summed across levels of information.

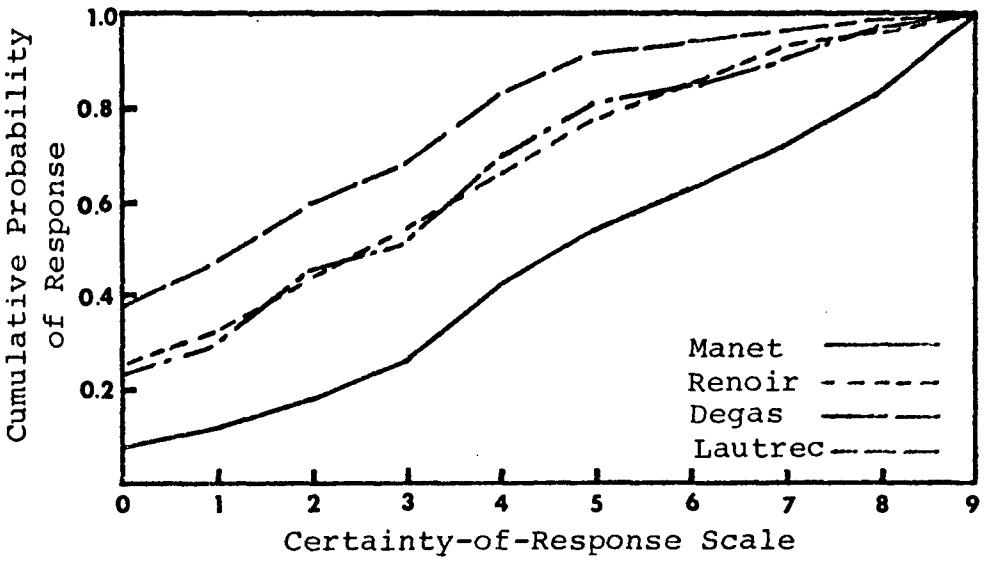


Figure 14. Immediate concept generalization: cumulative probability of certainty scale responses; passive responses to artists, summed across levels of information.

discerning that the styles of Manet and Lautrec were dissimilar, all training groups performed significantly better than controls. Lautrec was discriminated from Manet with significant accuracy by all four training groups. Between these two extremes, group performance as measured by mean ratings presents a complex picture that does not adhere to any strict pattern. In general the means of the control groups for all artists fall near the middle of the rating scale. Group 2 (active label-plus-rule) is the only training group to rate Renoir and Degas as significantly different from each other in their perceived distances from Manet, and their judgment of Renoir's style is significantly different from how Group 1 perceived both Renoir and Degas. Group 5 (passive label-plus-rule) rated Renoir and Degas significantly lower than Group 1 and Group 4 did, and significantly lower than Group 2 rated Renoir. Figure 15 is a graphic representation of mean ratings for artists as functions of treatments.

Analysis 2, Artists by Treatments Interaction: $\underline{d_m}$ Analysis

A significant interaction ($p < .001$) was also observed in the $\underline{d_m}$ analysis. Post hoc analysis revealed a much more consistent pattern of discrimination, with control groups performing at levels significantly below all training groups for each artist. As seen in the mean ratings analysis, Manet and Lautrec were consistently and significantly

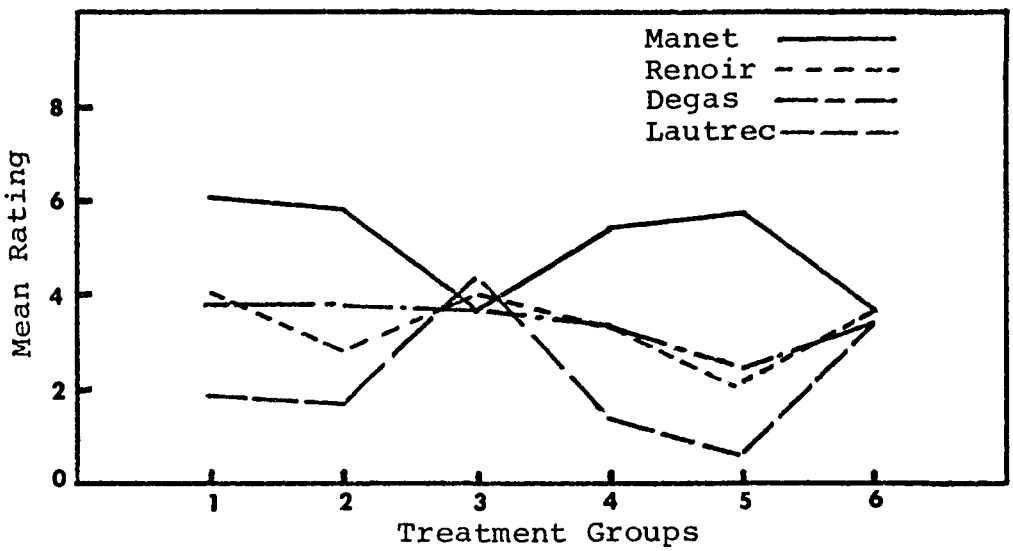


Figure 15. Immediate concept generalization, Analysis 2: mean certainty-of-response rating for artists as functions of treatments.

discriminated by all training groups, although not by controls. Group 5 (passive label-plus-rule) discriminated Lautrec as different from Manet significantly better than the other three training groups and significantly better than its own discrimination of Renoir. Group 5 discrimination of Degas was significantly farther from Manet, in terms of perceived distance, than Degas was ranked by any other training group. Group 5 discriminated Renoir from Manet significantly better than any of the other training groups. Group 2 (active label-plus-rule), however, perceived Renoir as significantly farther from the target than did either Group 1 (active label-only) or Group 4 (passive label-only). Group 2 also found the perceived distances of Renoir and

Degas from Manet to be significantly different. These effects are observable in graphic form in Figure 16.

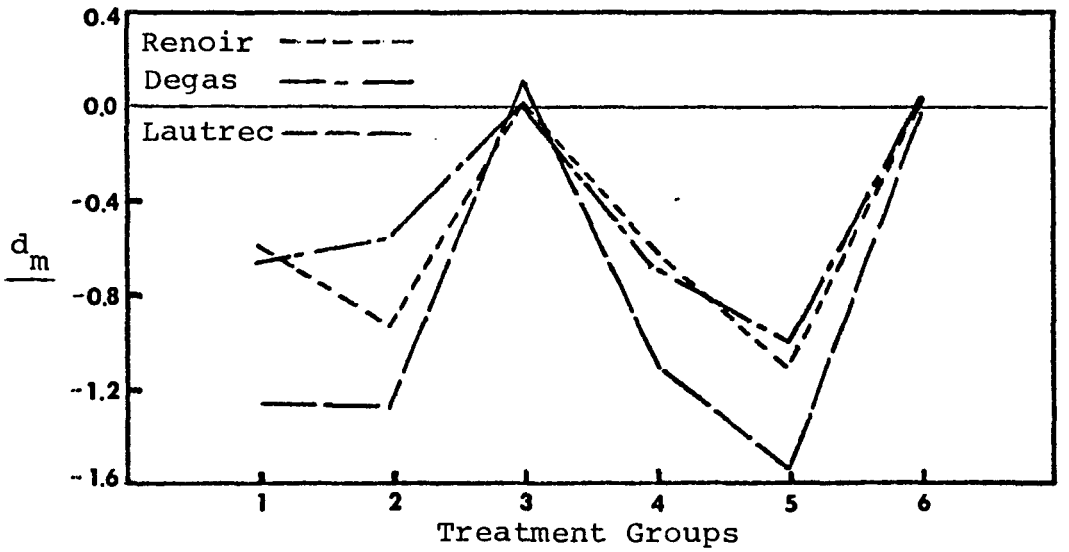


Figure 16. Immediate concept generalization, Analysis 2: d_m for artists as functions of treatments.

Slides: Mean Ratings Analysis

Slides as a variable were nested within artists. This was an important source of variance built into the experiment as a part of the TSD method, and was not tested for significance.

Slides-within-artists by levels-of-information interaction was significant ($p < .001$), indicating that levels of information significantly affected the way in which subjects identified slides belonging to various

artists. The active-passive factor also interacted significantly with slides ($p < .05$), but not as strongly. The three-way slides-within-artists by treatments (levels-of-information by active-passive) interaction was not significant according to mean ratings analysis.

Slides: d_m Analysis

The d_m analysis for immediate concept generalization, on the other hand, shows that all three of the above interactions were highly significant ($p < .001$).

Concept Retention and Delayed Generalization (Combined Data)

All of the results from these two tests are presented in combined form in the following paragraphs, on the basis of the similarity of results of the statistical tests, applied separately to data from the two sets of slides that form the assessment of retention and generalization. In each case, because the number of slides is small (twelve), and because the mean ratings analysis of combined data gave ambiguous results, the judgment of statistical similarity has been made on the basis of analysis using the signal detection statistic d_m. The results of these two analyses show only one serious discrepancy: the artists by levels-of-information by active-passive interaction is significant for concept retention ($p < .005$), but it is not significant for delayed generalization. Summary tables of both analyses

are included in Appendix A. Tables of traditional cumulative probabilities and the graphs drawn from them are available for both tests in Appendices B and C. Tables of TSD probabilities and graphs of ROC functions can be found in Appendices D and E. These show, group by group, the responses to the four artists as functions of the certainty-of-response scale, and part of the following chapter will be devoted to a discussion of the differences in group performance with respect to concept retention and generalization after delay.

Between-Groups Variables: Mean Ratings Analysis

The three between-groups factors (levels of information, active-passive, and the levels-of-information by active-passive interaction) were not significant according to mean ratings analysis.

Levels of Information: $\underline{d_m}$ Analysis

A significant difference ($p < .001$) was observed between levels of information by $\underline{d_m}$ analysis. Post hoc analysis indicated that both training conditions performed significantly better than the control condition, and that the label-plus-rule condition significantly outperformed the label-only training condition. Figure 17 is presented to compare the effects of levels of information in immediate generalization and concept retention-delayed generalization

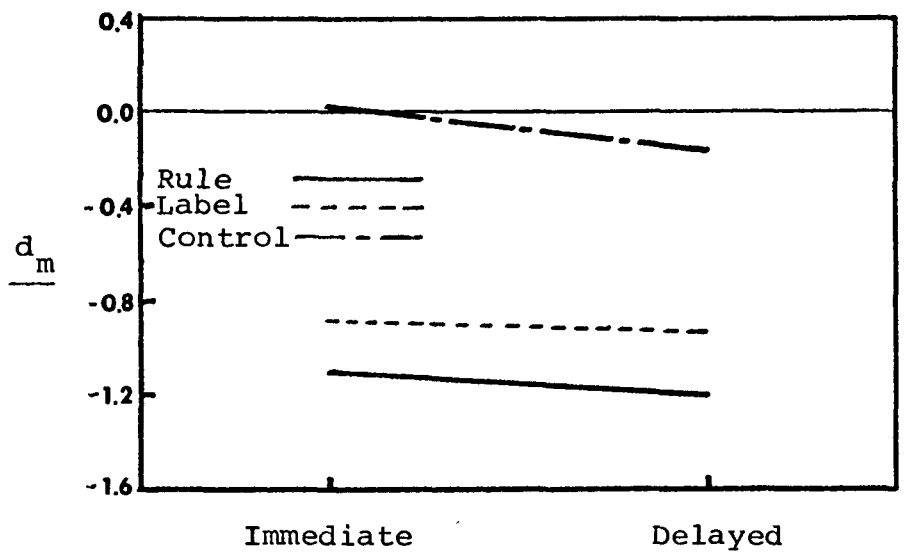


Figure 17. Immediate and delayed data: comparison of d_m as functions of levels of information, averaged across active-passive and artists.

data. Although an analysis of mean ratings did not produce significant results, it is evident in Figure 17 that there was no deterioration of the ability to distinguish noise artists from Manet for the levels-of-information factor.

Active-Passive:
d_m Analysis

A significant difference ($p < .001$) between active and passive conditions was observed by d_m analysis of delayed data. This factor was significant for immediate generalization as well, and if a comparison is made between immediate and delayed data (Figure 18) we can see that the tendency is for this factor to have a stronger effect after the delay. Groups learning under the passive condition

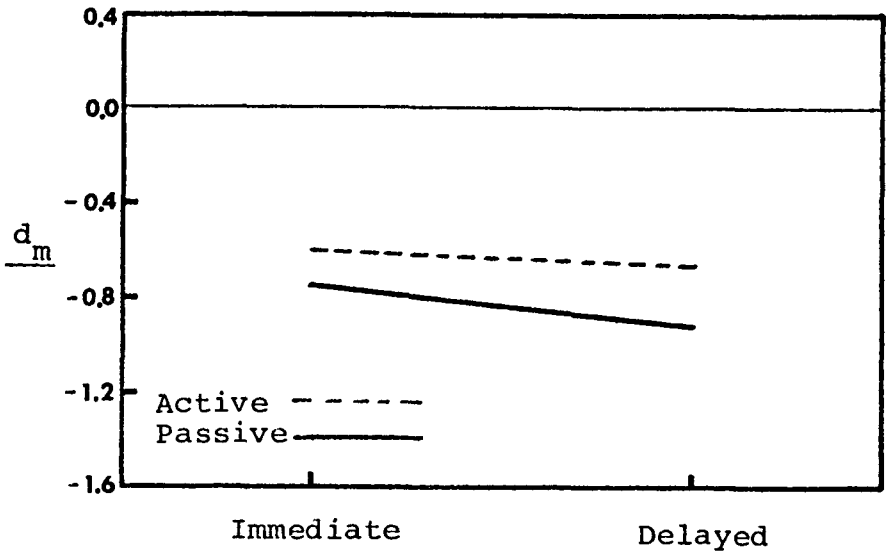


Figure 18. Immediate and delayed data: comparison of d_m as functions of active-passive conditions, averaged across levels of information and artists.

showed a tendency (untested) toward improved ability to distinguish Manet after two weeks.

Levels of Information by Active-Passive Interaction: d_m Analysis

A significant interaction ($p < .001$) was observed in the d_m analysis between these two factors after delay. Post hoc analysis revealed that all training groups performed significantly better than control groups. Group 5 (passive label-plus-rule) retained its ability to perform well; after two weeks Group 5 still performed significantly better than the other three training groups (Figure 19).

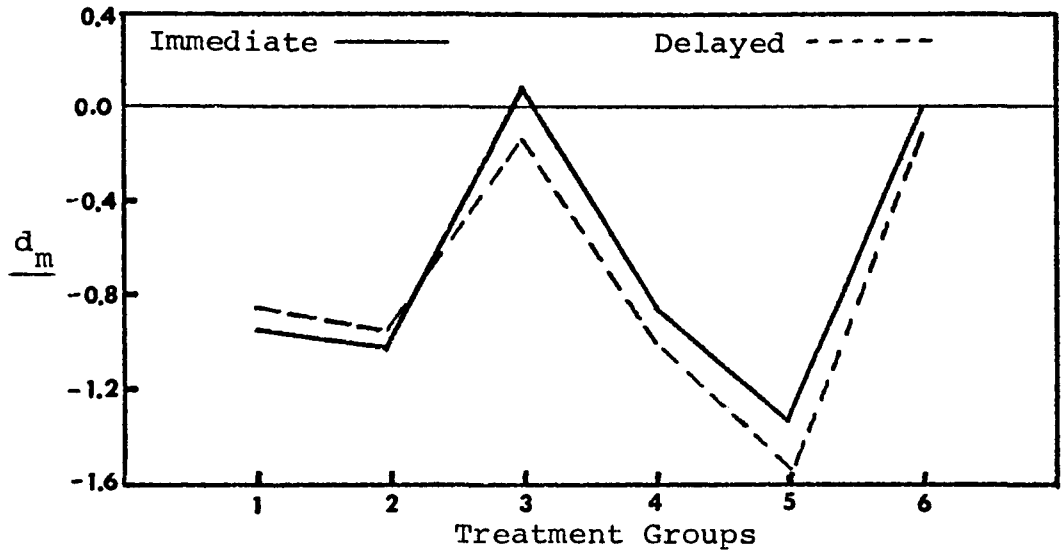


Figure 19. Immediate and delayed data: comparison of d_m as functions of treatment groups, summed across artists.

Artists: Mean Ratings Analysis

A significant difference in responses to artists ($p < .001$) can be observed in the mean ratings analysis. In Figure 20 we can see that mean ratings for Manet, Renoir, and Lautrec rose slightly from immediate to delayed testing, while ratings for Degas dropped by approximately the same amount. Post hoc analyses were only performed on d_m values.

Artists: d_m Analysis

This factor after delay is also significant at the $p < .001$ level by d_m analysis. By looking at results expressed in terms of d_m values (Figure 21) we observe that subjects' abilities to discriminate Renoir and Lautrec

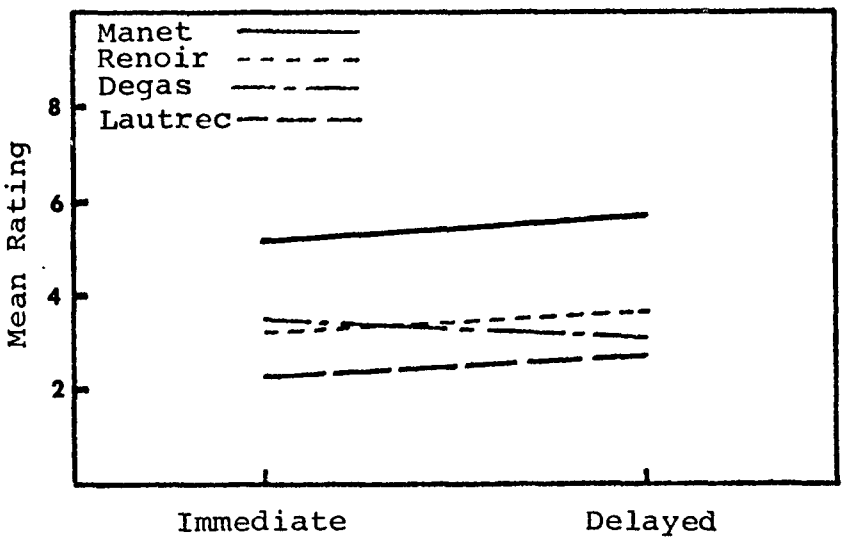


Figure 20. Immediate and delayed data: comparison of mean certainty-of-response ratings as functions of artists, averaged across levels of information and active-passive conditions.

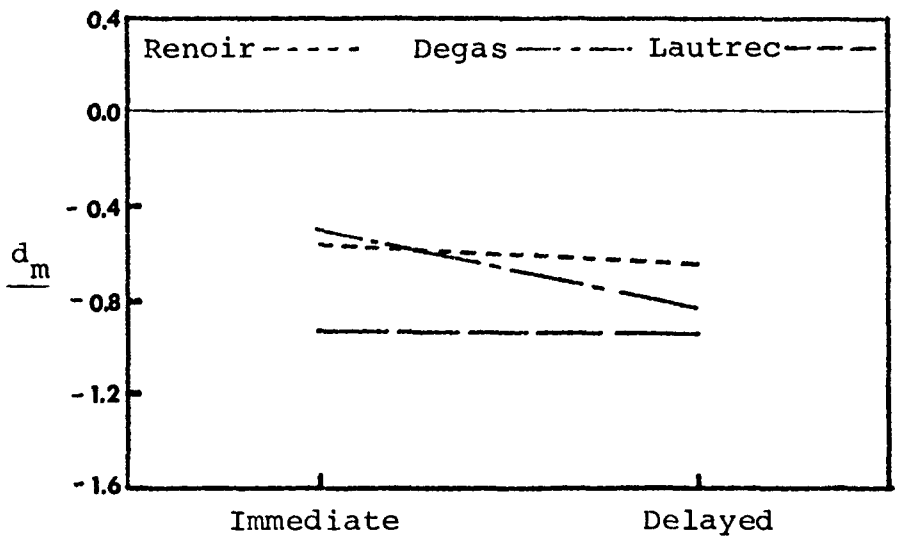


Figure 21. Immediate and delayed data: comparison of $\underline{d}_m$ values for artists, averaged across levels of information and active-passive conditions.

relative to Manet remained very stable over the two week period between immediate and delayed tests. The artist Degas, however, who was distinguishable from Manet to the same degree as Renoir immediately after training, was perceived as significantly different from Renoir's perceived distance from Manet, according to post hoc analysis (Figure 21).

Artists by Levels of Information Interaction: Mean Ratings Analysis

A significant interaction was observed between these two factors by mean ratings analysis ($p < .001$). Post hoc analysis indicated that both label and label-rule conditions were able to discriminate significantly between artists, and that control groups were not, but there were no significant differences between label-only and label-rule for any one artist.

Artists by Levels of Information Interation: $\underline{d_m}$ Analysis

This interaction is significant ($p < .001$) in terms of $\underline{d_m}$ analysis as well as mean ratings. Post hoc analysis showed that both information conditions were able to discriminate significantly between artists, that the no-information condition (control) could not, and that the label-plus-rule condition performed significantly better for each of the non-signal artists than the label-only condition in discriminating these artists from Manet. Figures 22, 23,

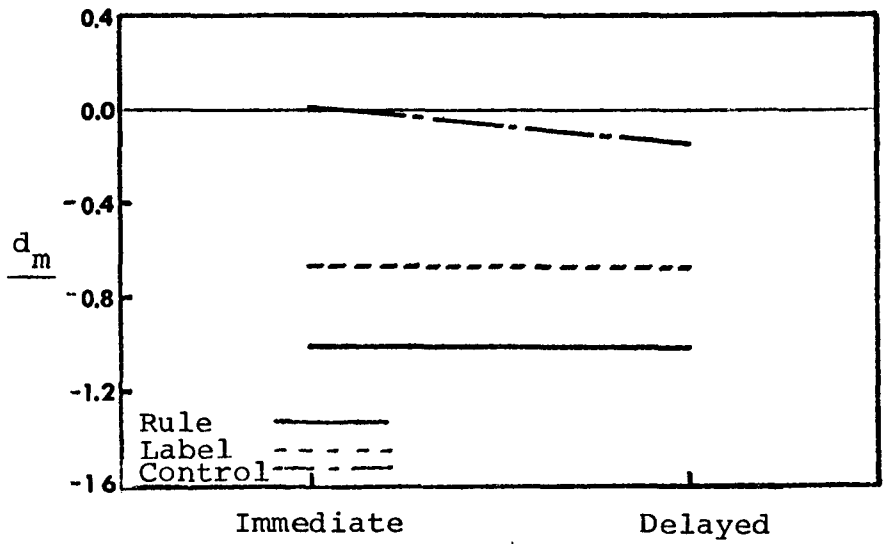


Figure 22. Immediate and delayed data: comparison of d_m for Renoir as functions of levels of information, averaged across active-passive.

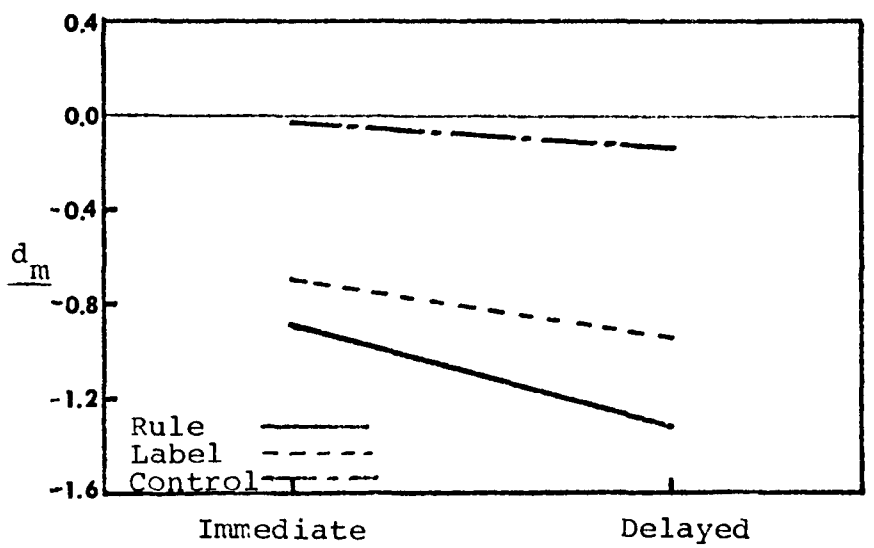


Figure 23. Immediate and delayed data: comparison of d_m for Degas as functions of levels of information, averaged across active-passive.

and 24 disentangle the interaction artist by artist and compare performances based on immediate generalization and on the combined delayed generalization and retention tests. Differences in responses can be seen with respect to each artist as a result of information levels. These differences are easier to observe from $\underline{d_m}$ data than from the raw rating scores.

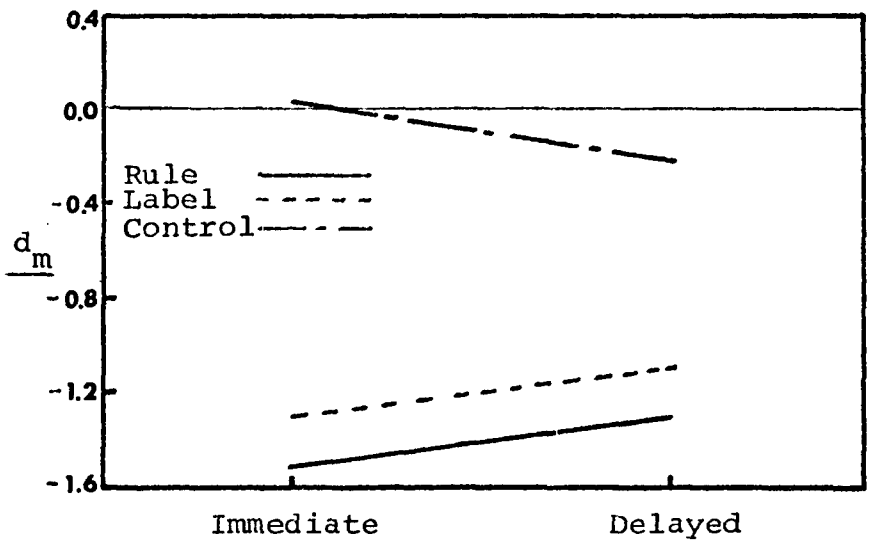


Figure 24. Immediate and delayed data: comparison of $\underline{d_m}$ for Lautrec as functions of levels of information, averaged across active-passive.

Artists by Active-Passive Interaction: Mean Ratings Analysis

A significant interaction ($p < .05$) was observed between artists and the active-passive factor two weeks after training. This interaction was significant in immediate generalization ($p < .05$) and has remained constant over delay. Significant differences appeared between artists in post hoc analysis, but not between active and passive conditions for any given artist.

Artists by Active-Passive Interaction: d_m Analysis

The d_m analysis shows this interaction significant after delay ($p < .01$), but according to d_m values the interaction was not significant immediately after training. Post hoc analysis of d_m values revealed not only significant differences between artists, but also showed the passive condition performing significantly better for each artist than the passive condition.

Artists by Treatments Interaction: Mean Ratings Analysis and d_m Analysis

This interaction was examined both during Analysis 1 and Analysis 2 with varying results. Analysis 1 showed this interaction not significant for mean ratings, but significant ($p < .05$) for d_m. Analysis 2 showed the interaction significant ($p < .001$) for mean ratings, but not significant for d_m.

Slides: Mean Ratings Analysis
and d_m Analysis

After two weeks the various slides-by-training conditions interactions still retained the identical levels of significance as immediately after training, with two exceptions in the comparative mean ratings analyses. The slides-within-artists by active-passive interaction was significant immediately following training ($p < .05$) but was not significant after delay. The slides-within-artists by levels-of-information by active-passive interaction was not significant immediately following training, but was significant two weeks later ($p < .001$).

Training Slide Recall

Levels of Information

A significant effect was observed in the levels of information factor ($p < .001$). Post hoc analysis revealed that both training conditions (label-plus-rule and label-only) were significantly different than the control condition, but not significantly different from each other. Figure 25 is a bar graph on which are plotted performances of treatment groups measured in number of correct answers. Figure 26 is a graph of d_m values for treatment groups (levels-of-information by active-passive interaction) from the combined concept retention and delayed generalization data. A comparison of the two graphs shows that in each

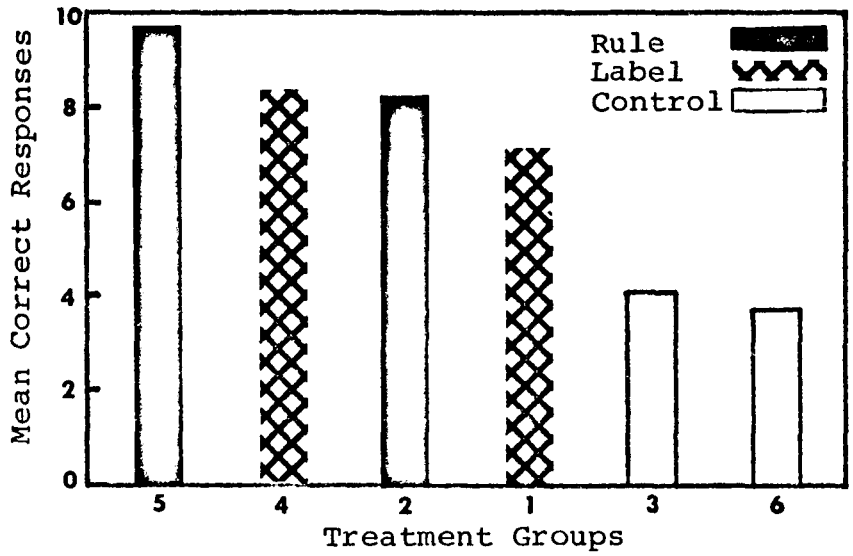


Figure 25. Training slide recall: mean correct answers as functions of treatments.

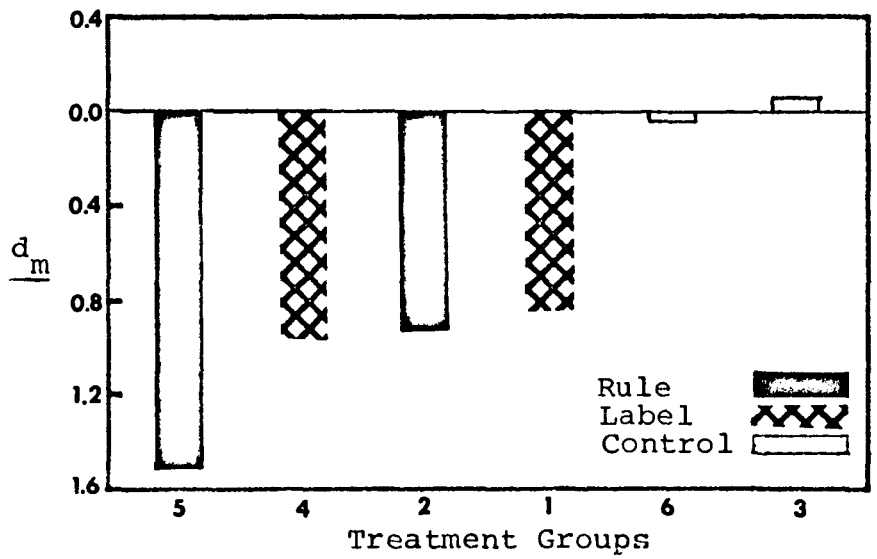


Figure 26. Concept retention and delayed generalization (combined data): $\underline{d}_m$ values as functions of treatment groups.

case the training groups are ordered as follows: the two passive groups preceding the two active ones, while within these two categories the label-plus-rule group always precedes the label-only group.

Aesthetic Preference

Between-Groups Variables: Mean Ratings Analysis

None of the between-groups variables comparisons were significant in terms of the mean ratings analysis of variance.

Levels of Information: d_m Analysis

A significant effect ($p < .001$) was observed in the levels of information factor as a result of d_m analysis. Post hoc testing showed that the label-only condition is significantly different in terms of preferences from both label-plus-rule and control. Figure 27 is a plot of the d_m values for each information level. It reveals that the label-only condition, alone, exhibited distinct preferences. Control and label-plus-rule conditions performed at the chance level.

Active-Passive

This factor is not significant by either means ratings or d_m analysis.

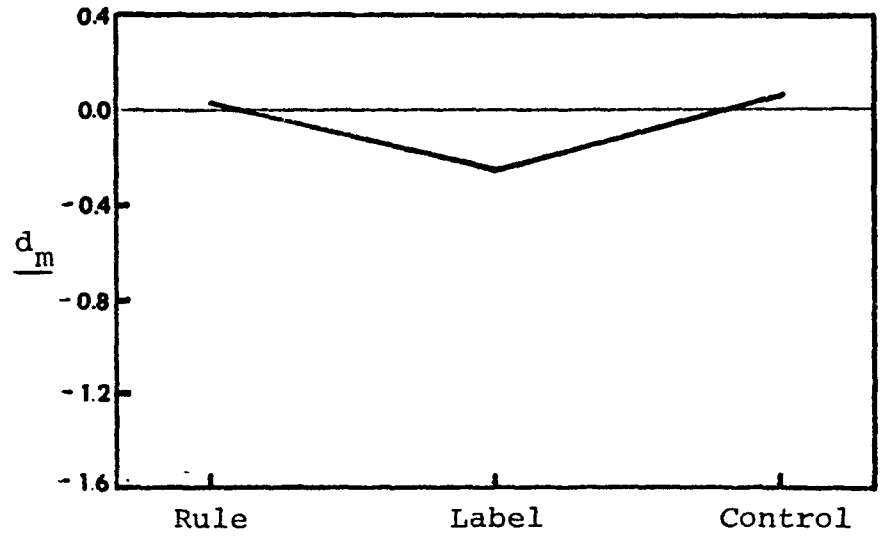


Figure 27. Aesthetic preference: d_m values as functions of levels of information, summed across artists and active-passive.

Levels-of-Information by Active-Passive Interaction: d_m Analysis

A significant interaction ($p < .005$) was observed through the d_m analysis. Group 4 (passive label-plus-rule) was significantly different from all other groups, according to post hoc analysis. This interaction is graphed in Figure 28.

Artists: Mean Ratings and d_m Analyses

A significant effect for artists was observed both in mean ratings and d_m analyses ($p < .001$). In terms of subject preference, artists remained an effective variable. It can be seen in graphs of traditional cumulative

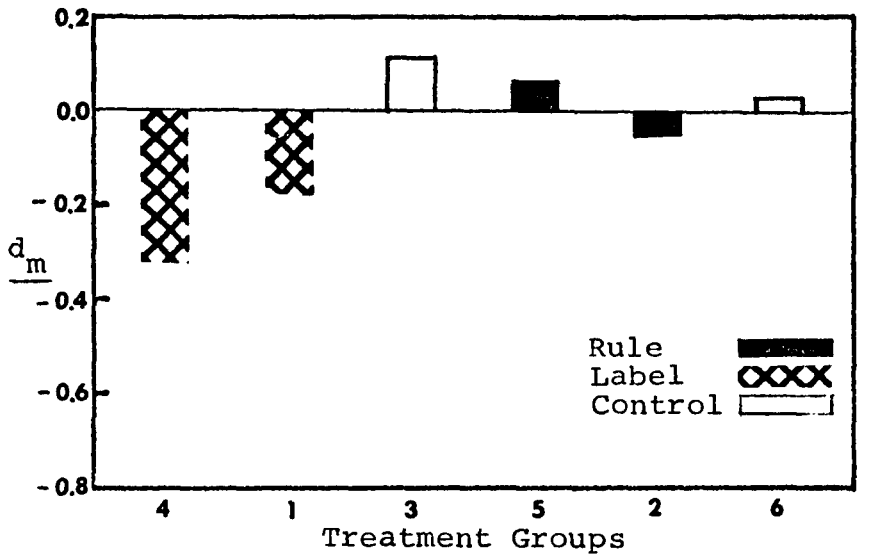


Figure 28. Aesthetic preference: d_m values as functions of treatment groups, summed across artists.

probabilities for the aesthetic preference test (Appendix C) that the artist preferred by all groups was Renoir.

Artists by Levels-of-Information Interaction: Mean Ratings and d_m Analyses

A significant interaction was observed by mean ratings ($p < .025$) and d_m ($p < .001$). Post hoc analysis showed that all groups preferred Renoir. Label-rule and control conditions preferred Renoir to Manet significantly more than label-only. The label-only condition liked Lautrec least, significantly less than label-rule. Control groups expressed no preference between Degas and Lautrec. The label-only condition disliked Lautrec significantly less

than Degas, and disliked both significantly less than either of the other two conditions. The label-only condition expressed a significantly greater range of preference than the label-rule condition did, but label-rule had a significantly greater range than the control condition.

Figure 29 is a graph of d_m values as functions of information levels and we can observe that label-only groups displayed a wider range of preferences than either label-plus-rule or control conditions.

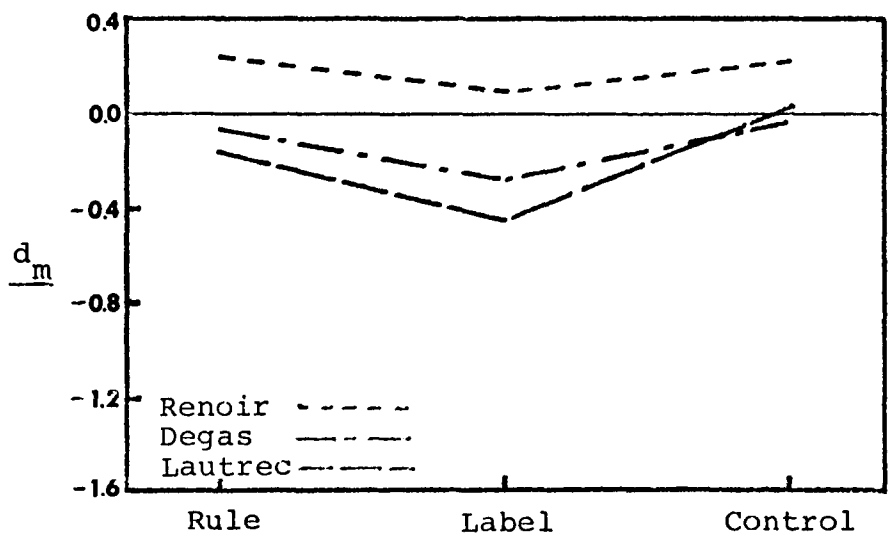


Figure 29. Aesthetic preference: d_m values for artists as functions of levels of information, summed across active-passive conditions.

Artists by Active-Passive Interaction:
d_m Analysis

This interaction was significant ($p < .05$), but only in the d_m analysis. The only artist to whom active and passive conditions responded in a significantly different fashion, according to post hoc tests, was the artist Lautrec.

Artists by Level-of-Information by
Active-Passive Interaction:
d_m Analysis

A significant interaction was observed but only by d_m analysis, Analysis 1 ($p < .005$). The artists by treatments interaction, Analysis 2, was not significant either for mean ratings or d_m. Post hoc analysis showed that Group 4 (passive label-only) displayed the strongest preferences of any group, with a range between high and low extremes that was significantly different from all other groups. Group 4 also had significant preference differences between all artists. Group 5 (passive label-rule) preferred Renoir significantly more than did Group 4, but Group 5's overall range was significantly less than Group 4. Figures 30 and 31 plot this interaction.

Slides: Mean Ratings Analysis
and d_m Analysis

Slide variables are all marginally significant except for slides by levels of information in mean ratings, which is marginally nonsignificant.

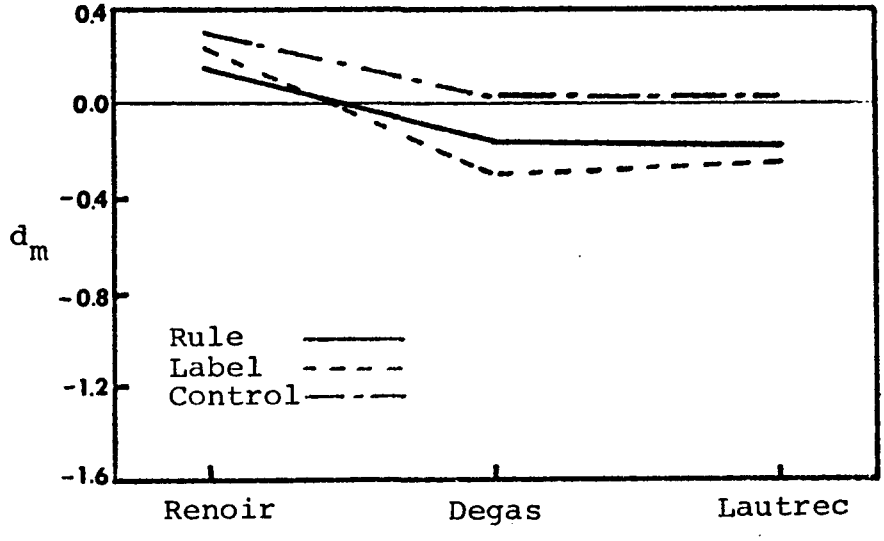


Figure 30. Aesthetic preference: $\underline{d_m}$ values as functions of artists for the active condition.

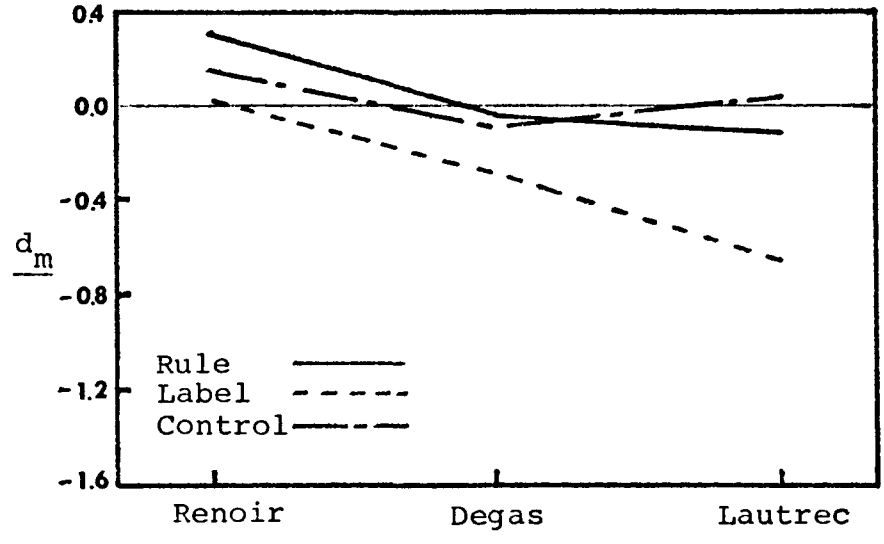


Figure 31. Aesthetic preference: $\underline{d_m}$ values as functions of artists for the passive condition.

Elicited Relevant Attributes

Two approaches to the data have been used with these written responses. First, the total number of criteria (regardless of content or artist) generated by each treatment group were tabulated and subjected to analysis of variance. For this purpose the number of subjects in each group was reduced to thirteen, as in the combined concept retention-delayed generalization and aesthetic preference analyses. Results are inconclusive ($p < .10$), but in general the tendency for levels of information to be a differentiating factor appears to carry through, here, as it has in the rest of the experiment.

Second, an attempt has been made to sort the criteria according to the specific attribute involved. If the percentage of total group responses did not reach .25 in any content classification established by the experimenter, that classification was considered nonfunctional and discarded. A complete list of these attributes, and graphs that permit comparisons among them, are located in Appendix G.

Responses were divided into the following three categories: (1) rules learned by the label-plus-rule condition during training and repeated back to the experimenter during the elicited criteria test; (2) criteria not taught during training, observed and reported solely by the label-only condition; (3) criteria reported predominantly by the

label-only condition, but mentioned with varying frequency by all training groups. Reports of control groups were not analyzed. Figure 32 is a bar graph plotted from the number of criteria generated for each artist that had a 25% response strength. From it we can assess the proportions of the three categories just listed, within the total number of criteria generated for each artist.

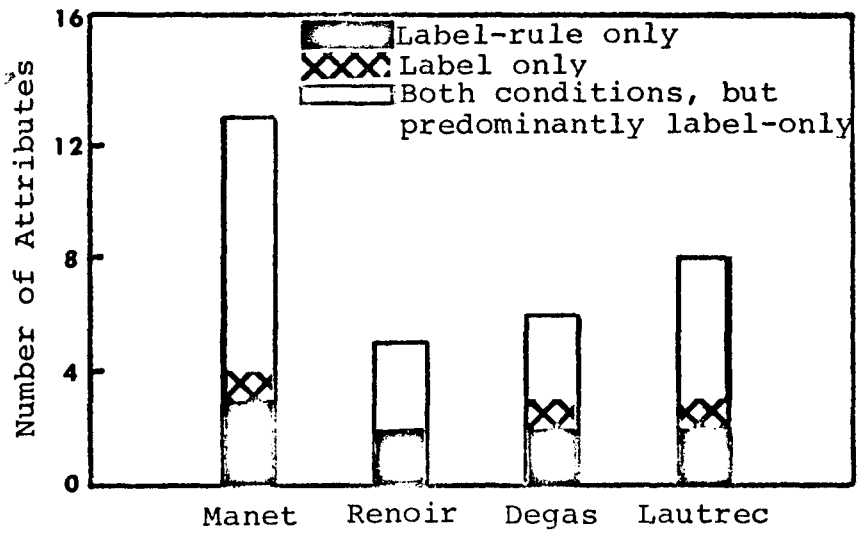


Figure 32. Elicited relevant attributes: rule-nonrule responses with a frequency of 25%, as functions of artists.

Some observed characteristics produced greater strength of response than others. Figure 33 is a bar graph of criteria whose percentages of response reached or exceeded forty per cent. The number of criteria generated with respect to each artist seems to correspond to its position in ROC description of perceived differences between artists. Manet generated the most criteria, Lautrec the next highest amount, and so forth.

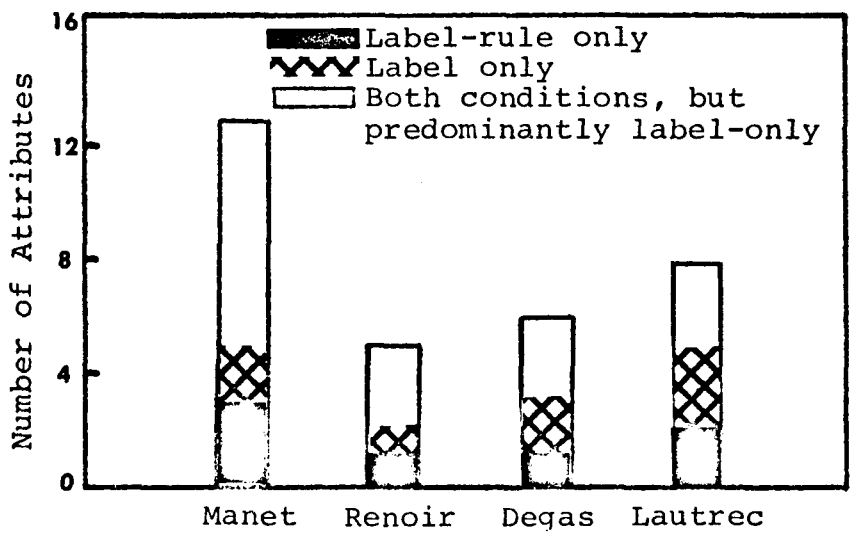


Figure 33. Elicited relevant attributes: rule-nonrule responses with a frequency of 40%, as functions of artists.

The chief characteristic of group responses relative to generating criteria has to do with rule learning. The effect of learning a rule for characterizing style, was to suppress spontaneous generation of style-defining criteria. Label-only groups reported more artist-specific stylistic characteristics than the label-plus-rule groups did. A more complete discussion of the relevant attributes that were elicited will be found in Appendix G.

CHAPTER 6

DISCUSSION

All training groups in the experiment displayed some level of concept attainment. For teaching concepts in art, a process involving nonverbal material and an aesthetic component, all of the instructional strategies examined were effective. The following discussion will touch on the relative merits of each one in light of the outcomes of the experiment.

Immediate Concept Generalization

Levels of Information: Label-Plus-Rule

In this experiment, the kind of information a subject received affected his performance on the immediate test of concept attainment. Subjects in the label-plus-rule condition identified Manet significantly more often and with greater confidence (by using higher ratings on the certainty-of-response scale) than did the label-only condition. The superior performance of the label-rule condition indicates that the more information a subject receives, the better his concept learning is likely to be.

The immediate assumption is that the rules used in the experiment were efficient with respect to the artists to

whom they were applied. By correctly pointing out relevant attributes of the painting styles in question, the rules facilitated concept attainment. Inefficient rules would be expected to impede concept formation or, at best, to have no effect. It is also possible that the rules were not efficient, but instead simply modeled rule-formation behavior. The rules used in the experiment may have enhanced students' discriminations of style differences, or they may have had no functional relationship to style concepts except to have facilitated memory by providing verbal coding.

The implications for teaching to be found in the superior performance of the label-plus-rule condition are that teaching rules will enhance performance on a task even when all of the stimulus dimensions cannot be specified. Further research is needed to determine the functional nature of the rule in learning a concept with more unspecified variables than those presented by the rule.

Label-Only

The label-only condition displayed a significantly greater amount of learning than the control condition, suggesting that a verbal label is not necessary to produce learning when a concept of painting style is being taught. It may be assumed that subjects in this condition spontaneously generated criteria relevant to concept formation, and that these may have been verbal or nonverbal (imagery).

Additional research may be able to discover whether or not the process was similar to the one that occurred in the label-rule condition, although covert, or whether it was a different one. The effects that differences in process would have on storage (retention) and subsequent use made of the material would be an interesting area of investigation, with considerable implications for teaching.

Control (No Information)

Controls who viewed the slides but received no information were unable to differentiate artists even though they knew the names of the artists, and how many artists there were. Control subjects reported later that they were able to identify paintings according to common stylistic characteristics, but could not label them correctly. The experimenter's speculation is that controls would have grouped slides similarly to subjects who participated in the preliminary sorting (Appendix H). These subjects sorted slides into groups that had internal style consistency, but included more than one artist.

Active-Passive: Passive Condition

Whether a subject was in the active or passive condition significantly affected his performance during immediate concept generalization. According to $\underline{d_m}$ analysis, subjects in the passive condition were considerably more sensitive to style differences than subjects in the active

condition, suggesting that verbal modeling is a successful approach to teaching style concepts. Observational concept-learning has been shown to be successful, and the most obvious assumption to make regarding the active-passive comparison is that the modeling procedure, rather than the content of the verbal material, is responsible for the significant effect observed. It is also possible that passive subjects attended to the content of the experimenter's remarks more than the active students did, or perhaps looked at the screen longer, simply out of the fact that they had more time in which to do so without manipulating pencil and paper.

Active Condition

While subjects in the passive condition displayed superior ability to discriminate the noise artists from Manet, the mean ratings given to artists were significantly higher in the active condition. It may be possible to explain this discrepancy between the mean ratings analysis and the $\underline{d_m}$ analysis by suggesting that the guessing-feedback procedure encouraged students to modify their guessing strategy, by making them aware of the a priori probabilities of the target-nontarget ratio (one in four). While learning did occur among students under the active condition, the implication that changes observed as a result of this type of teaching may not be attributable entirely to learning

should have important consequences for classroom procedures, where this sort of teaching method is often considered very successful. Additional research using signal detection methodology to separate out criterion states or guessing bias from commonly used performance measures would be of great benefit to many areas of education.

Levels-of-Information by Active-Passive Interaction

More specific evaluation of the performance of each treatment group shows that four groups attained style concepts as the result of training, while two groups without training performed at chance levels on the immediate generalization test. One group (Group 5, passive label-plus-rule) performed significantly better than the three other training groups. This result suggests that the combination of verbal modeling and rule learning does produce the most effective approach for complex concept learning using verbal material, as it has been suggested by others to be effective with verbal material.

Artists

Subjects in all groups responded very consistently to the works of the four artists used in the experiment. Because of having used Manet as a target artist and the rating scale to collect subject responses, we now can examine the graphs of cumulative probabilities to observe the

pattern of style differences as they were perceived between artists (Appendix C). The styles of Renoir and Degas were each judged by subjects to be significantly different from the style of Manet, but the amount of that difference is approximately the same. As a result, the certainty-of-response ratings assigned to Renoir and Degas were similar, and their lines on the cumulative probabilities graphs lie close together. The styles of Renoir and Degas were not as clearly distinguishable from that of Manet as was the style of Lautrec, who was perceived as so different that his ratings were significantly different from the ratings of Renoir and Degas as well. The increments in perceived distance from Manet to Renoir-Degas, and from Renoir-Degas to Lautrec, were approximately the same.

Artists by Levels-of-Information Interaction

In general, receiving more verbal information did not make subjects in the label-plus-rule condition better able to distinguish the signal artist from all noise artists. Both training conditions performed significantly better than controls in this respect, however, Subjects in the label-plus-rule condition discriminated Renoir from Manet significantly better than subjects in the label-only condition did, but this appears to be an exception rather than a meaningful effect.

Figures 34, 35, and 36 depict the simultaneous effects of artists and levels of information in terms of cumulative probabilities. The two conditions receiving information (label-only and label-rule) used the lower end of the scale for all three non-signal artists more than the control condition did, indicating greater confidence in distinguishing these from Manet.

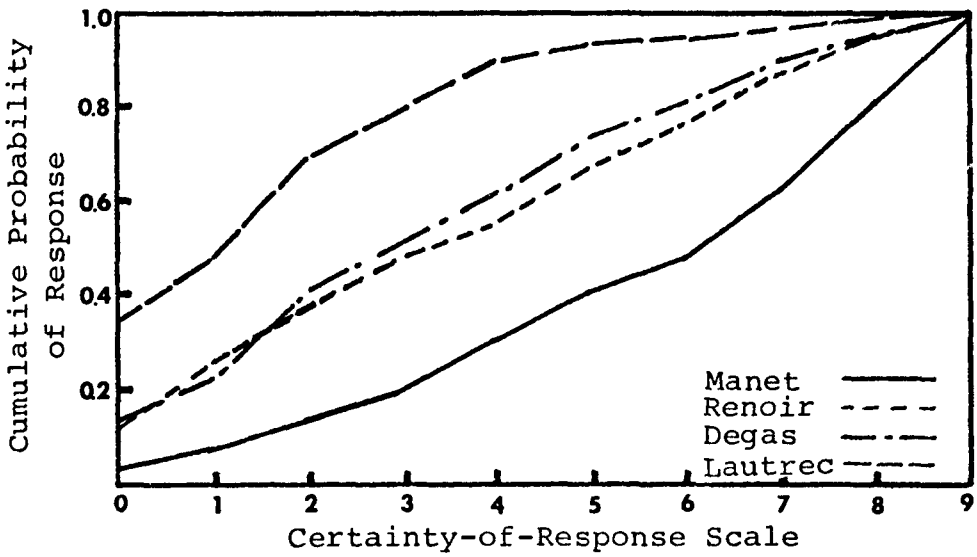


Figure 34. Immediate concept generalization: cumulative probability of certainty scale responses; label-only responses to artists, summed across active-passive conditions.

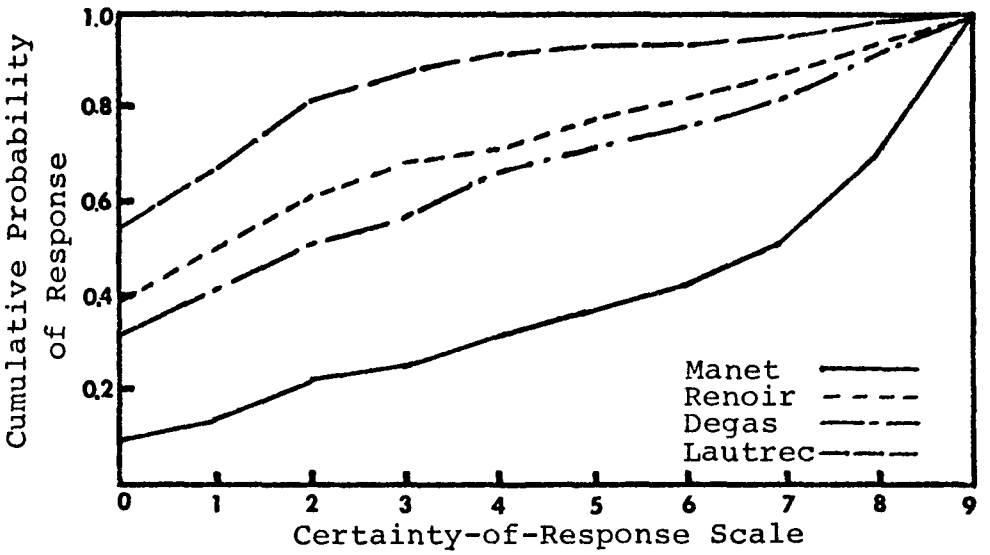


Figure 35. Immediate concept generalization: cumulative probability of certainty scale responses; label-plus-rule responses to artists, summed across active-passive conditions.

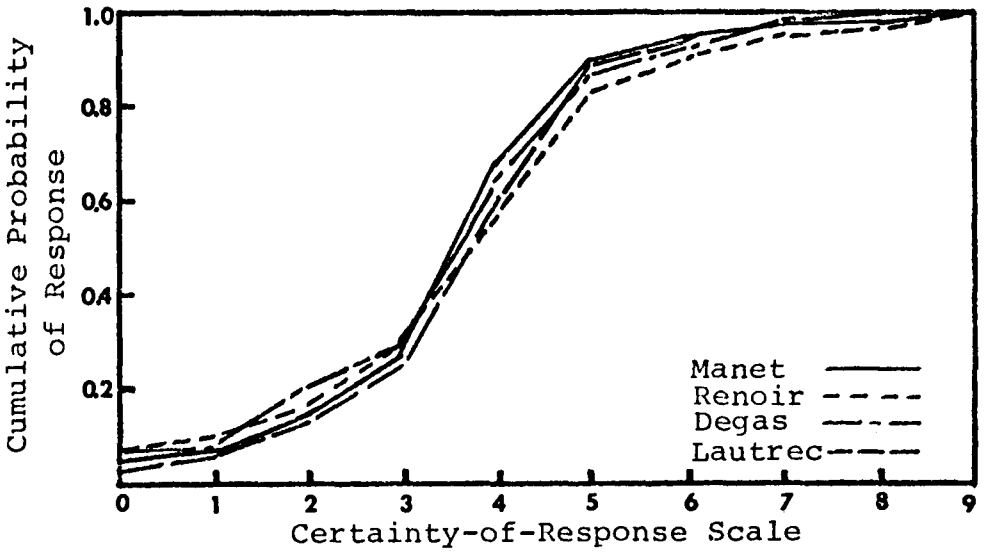


Figure 36. Immediate concept generalization: cumulative probability of certainty scale responses; control responses to artists, summed across active-passive conditions.

Figures 37, 38, 39, and 40 are graphs of cumulative probabilities of response that show performances of the three levels of information (label-only, label-plus-rule, and control) as functions of artists. Again it is clear that control groups consistently displayed great uncertainty in their response patterns, as distinguished from more confident responses of the training groups. While the label-plus-rule condition produced greater confidence about decisions in general, the sensitivity of the two information-level conditions was comparable from artist to artist.

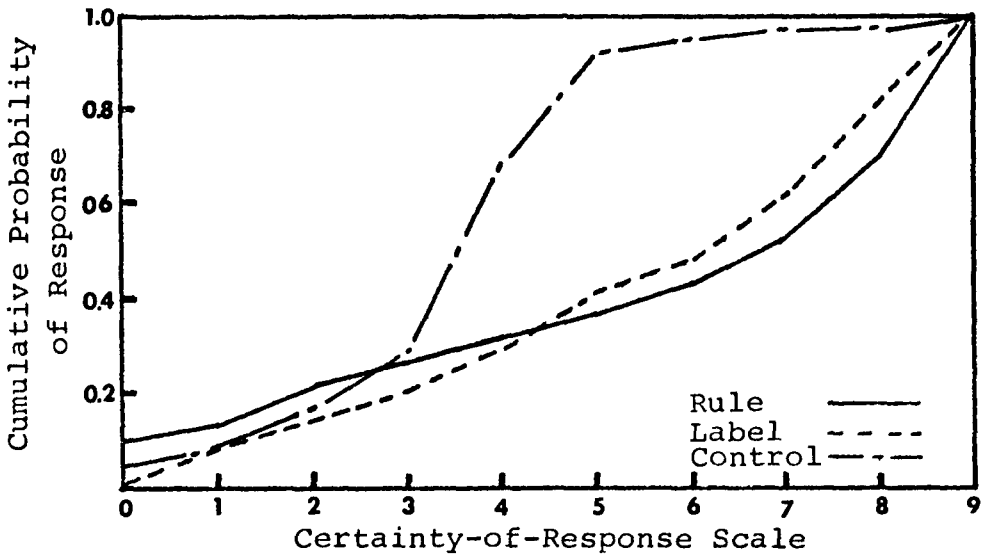


Figure 37. Immediate concept generalization: cumulative probability of certainty scale responses; levels of information responses to the artist Manet, summed across active-passive conditions.

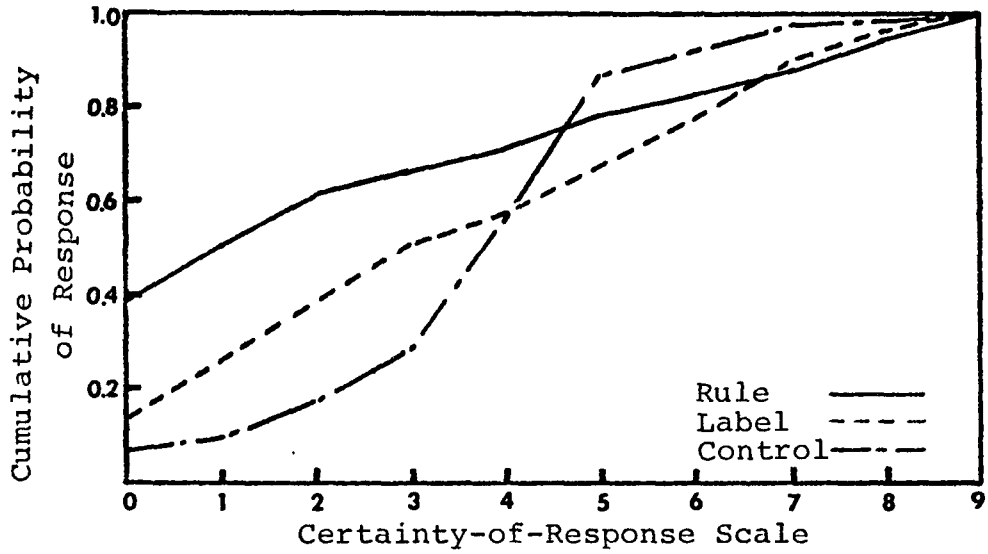


Figure 38. Immediate concept generalization: cumulative probability of certainty scale responses; levels of information responses to the artist Renoir, summed across active-passive conditions.

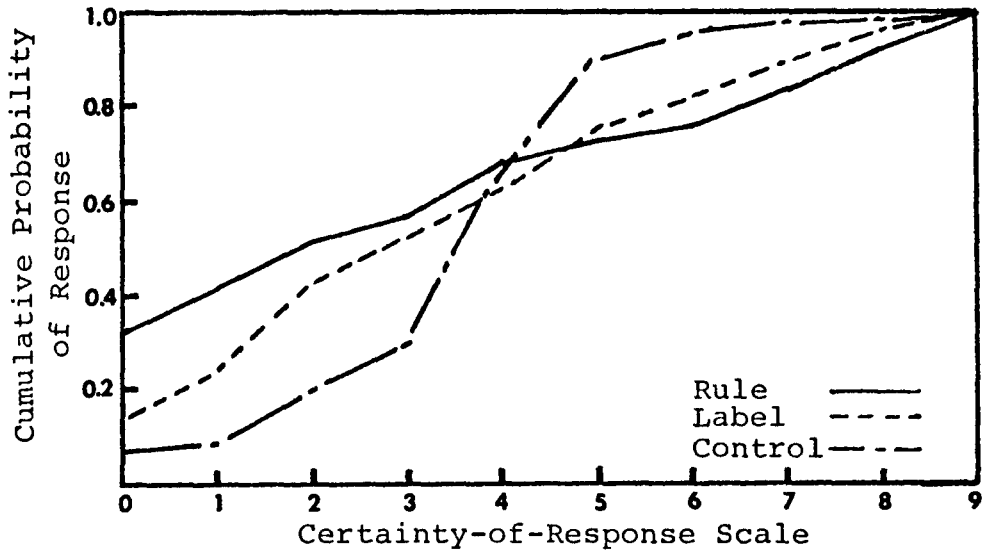


Figure 39. Immediate concept generalization: cumulative probability of certainty scale responses; levels of information responses to the artist Degas, summed across active-passive conditions.

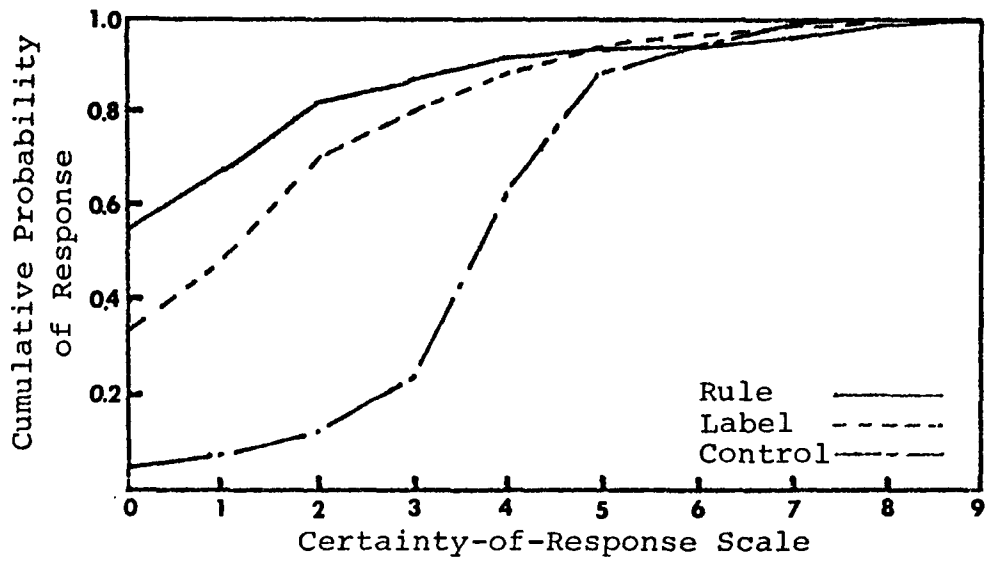


Figure 40. Immediate concept generalization: cumulative probability of certainty scale responses; levels of information responses to the artist Lautrec, summed across active-passive conditions.

Analysis 2, Artists by Treatments Interaction

Training affected the skill with which subjects discriminated Manet from the other three artists, and performance varied from group to group and artist to artist. Group 5 (passive label-plus-rule) performed significantly better with respect to each artist than any other training group. This consistency of results across artists is good evidence of the efficacy of this type of training program. The only other group to perform significantly above average was Group 2 (active label-plus-rule), which may be an indication that amount of information was a stronger influence

on learning than whether a condition was active or passive. Additional research might be done on the efficiency of rules by generating rules from both experts and naive subjects and comparing their effects in training. Efficient rules would be expected to affect both immediate generalization and retention.

Concept Retention and Delayed Generalization

Analyses using mean ratings and the signal detection index d_m provided virtually identical results from the immediate generalization data, but quite different results from the combined concept retention-delayed generalization data. This discrepancy was interpreted to mean that subjects' criterion states shifted as a result of delay. The passage of time apparently made subjects less sure of themselves, less willing to risk being wrong, but not less discriminating. If results had been analyzed in terms of raw rating scores alone, the strong, immediate generalization effect that was found would not have been shown to exist in significant strength after a two-week delay. By isolating individual subjects's criterion states, through application of signal detection methodology, it has been shown conclusively that concept strength remained high, while willingness to guess (response confidence) dropped as a result of delay.

Between-Groups Variables

The amount of information subjects received during training continued to affect concept retention and generalization two weeks later, as indicated by the fact that the label-plus-rule condition performed significantly better than any label-only condition at that time. This strong retention effect is good evidence acknowledging the success of rule learning as a concept-formation teaching procedure. An efficient rule can be expected to influence memory, and may be inferred from performance on retention tests.

The passive condition continued to significantly effect superior performance after delay. The passive label-plus-rule training group still performed significantly better than the other three training groups after two weeks had passed.

Artists Variables

Subjects continued to respond to artists in significantly varying patterns according to style, although the patterns have changed slightly. The perceived relationship of Degas to Manet underwent a significant change after delay. Immediately after training, Degas and Renoir were both judged to be equally distant from Manet; but Degas was perceived as considerably different from Manet two weeks later, and this distance was significantly different from Renoir's perceived distance from Manet, according to post hoc

analysis. A shift of this nature could be attributed to the fact that a more efficient rule was presented for Degas during training than for Renoir, resulting in more efficient encoding and memory processes.

After delay, the label-plus-rule condition performed, as expected, significantly better in discriminating each of the non-target artists from Manet. Unexpectedly, the effect of the passive condition on artists increased over two weeks.

Differential responses to artists continued to be significant over the two-week time span, but a slight shift in relative perceived distances of non-target artists from Manet can be observed by referring to the cumulative probabilities graphs for treatment groups (Appendix C). It is helpful in this respect to consider the concept retention data separately from the delayed generalization data.

Concept Retention

Regarding slides previously used in immediate generalization, all training groups showed a heightened ability to perceive the styles of the two middle artists (Renoir and Degas) as different distances from Manet, although passive label-only subjects (Group 4) were more sensitive than all others in this respect. Group 5 (passive label-plus-rule) showed a remarkable increase in the ability to identify all other artists as distinct from Manet. For

all groups, familiarity apparently interacted with perceived style differences to improve accuracy of discrimination toward all four artists.

Delayed Generalization

When viewing slides not previously seen, subjects in all training groups clearly showed ability to distinguish Manet, but seemed to consider all non-target artists as though they were approximately the same perceived distance from the target artists. Subjects appeared to be using a bipolar answering scale, allowing only Manet or not-Manet choices. Group 5 (passive label-plus-rule) shows a very large range between the yes and no extremes, perhaps indicating that part of the efficiency of rule learning is the ability to simplify alternatives, by directing the viewer's attention to a few specific defining attributes.

Aesthetic Preference

Artists

The artists used in the experiment did evoke considerable variety of like-dislike opinions from subjects, enough range to be a significant effect. The artist preferred by all groups, although in varying degrees, was Renoir. It was hypothesized by the experimenter upon beginning the study that subjects would prefer Manet, as a result of having their attention called to his work as

target artist in the detection task. This did not turn out to be the case. If subjects had preferred Manet, it might have been difficult to be certain that their preference was the result of training. Subjects' preference for Manet could have been there before they participated in the experiment. All subjects significantly preferred Renoir to Manet, however, while training apparently affected the strength of this preference.

Artists by Levels-of-Information Interaction

In light of the consistent results of training for concept attainment, the effects of training on preferences are interesting. The kinds or amount of information a subject received differentially affected his aesthetic judgment. Whether he was in an active or passive condition, however, did not significantly affect his preferences.

The label-plus-rule condition preferred Renoir to Manet significantly more than the label-only condition did, although label-only also preferred Renoir significantly more than Manet. The label-only group liked Lautrec significantly less than the label-rule group did, so that between those two artists the label-only groups had a greater range of likes and dislikes than the label-rule groups. Specifically, Group 4 (passive label-only) had the most pronounced differences between likes and dislikes, although Group 5 (passive label-plus-rule) exhibited the greatest preference

for Renoir of any group. It seems fair to wonder whether, although Group 5 performed so competently on concept-attainment tasks, they may have enjoyed it significantly less than the other groups.

Untreated Data

There remains the very interesting question of the perceived relationships between works within one artist's style, or the relationships between the styles of one artist and another. There is unexplored information remaining in the data of this experiment, and this concerns the individual slides of paintings that were used as stimuli. The first analysis of variance, through use of the d_m measure, provided a method for disclosing the degree to which any given painting was, or was not, viewed as typical of its author's style. Each stimulus could be examined separately, regarding its stylistic similarity to works of the original artist. No mention has been made in the discussion of results either of stylistic properties of paintings in the oeuvre of one artist, or of observable features of any artist's style in relation to any other artist used in the experiment. These analyses may be carried out as time and resources permit. The possibility of discovering the specific characteristics that allow us to make discriminations between styles is one of the most interesting directions of the study. An initial attempt to achieve some

understanding of the distinguishing attributes used by subjects to discriminate styles now forms Appendix G. This material does not specifically related to the main experimental effects discussed in the text, but holds much promise for future research into an unknown area.

APPENDIX A

STATISTICAL ANALYSES

ANOVA 1: Immediate Concept Generalization, Mean Ratings Analysis Summary Table

Source	df	SS	MS	F	P
Between					
D	2	404.6116	202.3058	12.4291	.001
E	1	224.0352	224.0352	13.7641	.001
DE	2	73.6216	36.8108	2.2615	NS
C/DE	114	1855.5462	16.2767		
Within					
A	3	4728.4172	1576.1390	222.0445	.001
AD	6	2876.1183	479.3530	67.5306	.001
AE	3	48.1622	16.0540	2.2616	.05
ADE	6	95.7483	15.9580	2.2481	.05
A x C/DE	342	2427.6287	7.0983		
B/A	36	3303.3974	91.7610		
B/A x D	72	2396.1700	33.2801	8.0369	.001
B/A x E	36	229.1275	6.3646	1.5370	.05
B/A x DE	72	339.6300	4.7170	1.1391	NS
B/A x C/DE	4104	16994.5749	4.1409		
Tot.	4799	35996.7897			

A,4 B,10 C,20 D,3 E,2

A = Artists
B = Slides
C = Subjects
D = Levels of Information (Label, Label-plus-rule, Control)
E = Active-Passive (Feedback, No Feedback)

ANOVA 1: Immediate Concept Generalization, d_m Analysis Summary Table

Source	df	SS	MS	F	P
Between					
D	2	427.9749	213.9874	301.8585	.001
E	1	8.0663	8.0663	11.3787	.005
DE	2	13.1103	6.5551	9.2470	.001
C/DE	48	34.0313	0.7089		
Within					
A	2	51.2618	25.6309	208.2120	.001
AD	4	37.2586	9.3146	75.6677	.001
AE	2	.3270	0.1635	1.3281	NS
ADE	4	2.1735	0.0381	4.4134	.005
A x C/DE	96	11.8362	0.1231		
B/A	27	132.1285	4.8936		
B/A x D	54	88.2284	1.6338	28.9680	.001
B/A x E	27	10.0382	0.3717	6.5904	.001
B/A x DE	54	13.5781	0.2514	4.4578	.001
B/A x C/DE	1296	73.1717	0.0564		
TOT.	1619	903.1752			

A,3 B,10 C,9 D,3 E,2

A = Artists
B = Slides
C = Certainty-of-response levels
D = Levels of Information (Label, Label-plus-rule, Control)
E = Active-Passive (Feedback, No Feedback)

ANOVA 2: Mean Ratings Analysis Summary Table

Immediate Concept Generalization		Concept Retention and Delayed Generalization		Aesthetic Preference	
A,4 B,20 C,6		A,4 B,13 C,6		A,4 B,13 C,6	
Source	df	SS	MS	F	P
Immediate Concept Generalization:					
Between					
C	5	71.6538	14.3308	8.8374	.001
B/C	114	184.8661	1.6216		
Within					
A	3	477.9242	159.3080	224.0934	.001
AC	15	302.5098	20.1673	28.3686	.001
A x B/C	342	243.1383	0.7109		
TOT.	479	1280.0924			
Concept Retention and Delayed Generalization:					
Between					
C	5	17.8271	3.5654	1.6092	NS
B/C	72	159.5199	2.2155		
Within					
A	3	405.2334	135.0778	114.3854	.001
AC	15	190.9530	12.7302	10.7800	.001
A x B/C	216	255.0784	1.1809		
TOT.	311	1028.6121			
Aesthetic Preference:					
Between					
C	5	15.4123	3.0824	0.6220	NS
B/C	72	356.7761	4.9552		
Within					
A	3	63.3365	21.1121	19.0216	.001
AC	15	19.0730	1.2715	1.1455	NS
A x B/C	216	239.7453	1.1099		
TOT.	311	694.3434			

A = Artists
B = Subjects
C = Treatments

ANOVA 2: d_m Analysis Summary Table

Immediate Concept Generalization	Concept Retention and Delayed Generalization	Aesthetic Preference
A,3 B,20 C,6	A,3 B,13 C,6	A,4 B,13 C,6

Source	df	SS	MS	F	P
Immediate Concept Generalization:					
Between					
C	5	87.9446	17.5889	118.7636	.001
B/C	114	16.8864	0.1481		
Within					
A	2	9.3068	4.6534	83.9963	.001
AC	10	6.8778	0.6877	12.4133	.001
A x B/C	228	12.6505	0.0554		
TOT.	359	133.6645			
Concept Retention and Delayed Generalization:					
Between					
C	5	43.9076	8.7815	43.4083	.001
B/C	72	14.5698	0.2023		
Within					
A	2	2.3393	1.1697	11.7077	.001
AC	10	1.6472	0.1647	1.6484	NS
A x B/C	144	14.3953	0.0999		
TOT.	233	76.8595			
Aesthetic Preference:					
Between					
C	5	1.4385	0.2877	0.9473	NS
B/C	72	21.8727	0.3037		
Within					
A	2	3.9381	1.9691	33.2040	.001
AC	10	.8860	0.0886	1.4940	NS
A x B/C	144	8.5532	0.0593		
TOT	233	36.6887			

A = Artists
B = Subjects
C = Treatments

ANOVA 1: Concept Retention and Delayed Generalization, Combined Data: Mean Ratings Analysis Summary Table

Source	df	SS	MS	F	P
Between					
D	2	56.7532	28.3766	2.3506	NS (.10)
E	1	21.3675	21.3675	1.7700	NS (.20)
DE	2	23.5267	11.7633	0.9744	NS
C/DE	72	896.1859	12.0720		
Within					
A	3	2311.3055	770.4351	95.6717	.001
AD	6	871.9861	145.3310	18.0470	.001
AE	3	74.1965	24.7321	3.0712	.05
ADE	6	57.9989	9.6664	1.2003	NS
A x C/DE	216	1739.4292	8.0529		
B/A	20	1328.0598	66.4029		
B/A x D	40	575.0299	14.3757	3.3425	.001
B/A x E	20	103.4103	5.1705	1.2022	NS (.25)
B/A x DE	40	177.2692	4.4317	1.0304	.001
B/A x C/DE	1440	6193.2307	4.3008		
TOT.	1871	14402.7500			

A,4 B,10 C,13 D,3 E,2

A = Artists
B = Slides
C = Subjects
D = Levels of Information (Label, Label-plus-rule, Control)
E = Active-Passive (Feedback, No Feedback)

ANOVA 1: Concept Retention and Delayed Generalization, Combined Data: d_m Analysis Summary Table

Source	df	SS	MS	F	P
Between					
D	2	196.9070	98.4535	248.1186	.001
E	1	13.8514	13.8514	34.9077	.001
DE	2	16.1678	8.0390	20.3727	.001
C/DE	48	19.0469	0.3968		
Within					
A	2	13.1162	6.5581	101.0493	.001
AD	4	5.2643	1.3160	20.2788	.001
AE	2	0.6940	0.3470	5.3466	.01
ADE	4	0.7543	0.1885	2.9044	.05
A x C/DE	96	6.2345	0.0649		
B/A	15	80.4800	5.3653		
B/A x D	30	30.4315	1.0143	16.6825	.001
B/A x E	15	3.4541	0.2302	3.7861	.001
B/A x DE	30	8.9512	0.2983	4.9062	.001
B/A x C/DE	720	43.8364	0.0608		
TOT.	971	439.1901			

A,3 B,10 C,9 D,3 E,2

A = Artists
B = Slides
C = Certainty-of-response Levels
D = Levels of Information (Label, Label-plus-rule, Control)
E = Active-Passive (Feedback, No Feedback)

ANOVA 1: Concept Retention and Delayed Generalization, Combined Data: Comparisons of Four Mean Ratings Analyses with Different Subjects Summary Tables

Source	df	F	P	F	P	F	P	F	P
Between									
D	2	2.3506	NS	2.8137	NS	1.7298	NS	1.5383	NS
E	1	1.7700	NS	1.5621	NS	0.9404	NS	1.7996	NS
DE	2	0.9744	NS	0.7582	NS	1.0726	NS	1.0581	NS
Within									
A	3	95.6717	.001	113.0840	.001	103.6996	.001	118.9862	.001
AD	6	18.0470	.001	21.6039	.001	22.4711	.001	21.8915	.001
AE	3	3.0712	.05	0.6422	NS	3.6185	.025	1.5770	NS
ADE	6	1.2003	NS	2.0401	NS	1.3272	NS	2.6746	.025
B/A x D	40	3.3425	.001	3.6045	.001	3.6124	.001	3.5984	.001
B/A x E	20	1.2022	NS	0.5522	NS	0.8271	NS	1.0018	NS
B/A x DE	40	1.0304	.05	0.9438	NS	1.0863	.05	0.8879	NS

A = Artists
B = Slides
C = Subjects
D = Levels of Information
E = Active-Passive

ANOVA 1: Concept Retention: d_m Analysis Summary Table

Source	df	SS	MS	F	P
Between					
D	2	81.5280	40.7640	169.2857	.001
E	1	5.6404	5.6404	23.4235	.001
DE	2	6.0562	3.0281	12.5751	.001
C/DE	48	11.5605	0.2408		
Within					
A	2	10.6425	5.3212	79.0668	.001
AD	4	8.4333	2.1083	31.3268	.001
AE	2	0.4285	0.2142	3.1827	.05
ADE	4	1.2368	0.3092	4.5943	.005
A x C/DE	96	6.4629	0.0673		
B/A	6	27.5079	4.5846		
B/A x D	12	9.6792	0.8066	15.2188	.001
B/A x E	6	2.6895	0.4482	8.4566	.001
B/A x DE	12	3.1845	0.2653	5.0056	.001
B/A x C/DE	288	15.2803	0.0530		
TOT.	485	190.3322			

A,3 B,10 C,9 D,3 E,2

A = Artists
B = Slides
C = Certainty-of-response Levels
D = Levels of Information (Label, Label-plus-rule, Control)
E = Active-Passive (Feedback, No Feedback)

ANOVA 1: Delayed Generalization: d_m Analysis Summary Table

Source	df	SS	MS	F	P
Between					
D	2	118.8938	59.4469	181.4618	.001
E	1	7.5798	7.5798	23.1373	.001
DE	2	11.3259	5.6629	17.2860	.001
C/DE	48	15.7268	0.3276		
Within					
A	2	3.4956	1.7478	36.7957	.001
AD	4	1.6481	0.4120	8.6736	.001
AE	2	0.3679	0.1839	3.8715	.05
ADE	4	0.2387	0.0596	1.2547	NS
A x C/DE	96	4.5657	0.0475		
B/A	6	50.5581	8.4263		
B/A x D	12	17.2002	1.4333	20.7724	.001
B/A x E	6	1.4206	0.2367	3.4303	.005
B/A x DE	12	5.0392	0.4199	6.0855	.001
B/A x C/DE	288	19.8858	0.0690		
TOT.	485	257.9480			

A,3 B,10 C,9 D,3 E,2

A = Artists
B = Slides
C = Certainty-of-response Levels
D = Levels of Information (Label, Label-plus-rule, Control)
E = Active-Passive (Feedback, No Feedback)

ANOVA 2: Concept Retention and Delayed Generalization, Combined Data: Newman-Keuls Post Hoc Comparisons of Means Mean Ratings Analysis

1. Artists x Treatments Interaction

Manet

$D_c = 1.531$

Group	Mean	6.231	6.125	5.831	4.446	4.085
5	7.054	0.823	0.931	1.223	2.608	2.969
4	6.231		0.108	0.400	1.785	3.262
2	6.123			0.292	1.677	2.038
1	5.831				1.385	1.746
3	4.446					0.361
6	4.085					

Renoir

$D_c = 1.531$

Group	Mean	4.215	3.685	3.592	3.508	2.946
4	4.431	0.216	0.746	0.839	0.923	1.485
3	4.215		0.530	0.623	0.707	1.269
6	3.685			0.093	0.177	0.739
1	3.592				0.084	0.730
2	3.508					0.562
5	2.946					

Degas

D_c = 1.531

Group	Mean	3.669	3.138	2.777	2.569	1.915
3	4.269	0.600	1.131	1.492	1.700	2.354
6	3.669		0.531	0.892	1.100	1.754
1	3.138			0.361	0.569	1.223
4	2.777				0.208	0.862
2	2.569					0.654
5	1.915					

Lautrec

D_c = 1.531

Group	Mean	3.638	2.454	2.408	1.831	1.608
3	4.023	0.385	1.569	1.615	2.192	2.415
6	3.638		1.184	1.230	1.807	2.030
2	2.454			0.046	0.623	1.469
1	2.408				0.577	0.800
5	1.831					0.223
4	1.608					

ANOVA 2: Concept Retention and Delayed Generalization, Combined Data: Newman-Keuls Post Hoc Comparisons of Means d_m Analysis

1. Treatments

$D_c = 0.723$

Group	Mean	-.835	-.747	-.731	-.085	-.071
5	-1.301	0.466	0.554	0.570	1.216	1.230
2	-.835		0.088	0.104	0.750	0.764
1	-.747			0.016	0.662	0.676
4	-.731				0.646	0.660
6	-.085					0.014
3	-.071					

Training Slide Recall: Analysis of Variance
Summary Table

Source	df	SS	MS	F	P
A	1	12.32	12.32	3.04	NS
B	2	367.25	183.62	45.45	.001
AB	2	13.87	6.93	1.71	NS
S(AB)	72	291.24	4.04		
TOT.	77	684.68			

S_{78} $(A_2$ $B_3)$

A = Active-Passive (Feedback, No Feedback)

B = Levels of Information (Label, Label-plus-rule, Control)

ANOVA 1: Aesthetic Preference Mean Ratings
Analysis Summary Table

Source	df	SS	MS	F	P
Between					
D	3	123.0010	61.5005	2.0534	NS (.20)
E	1	21.7970	21.7970	0.7277	NS
DE	2	40.5972	20.2986	1.3554	NS
C/DE	72	2156.4166	29.9502		
Within					
A	3	329.1709	109.7236	17.8676	.001
AD	6	89.5373	14.9228	2.4300	.025
AE	3	25.1346	8.3782	1.3643	NS
ADE	6	18.0352	3.0058	0.4894	NS
A x C/DE	216	1326.4551	6.1409		
B/A	20	1445.9487	72.2974		
B/A x D	40	136.6666	3.4166	0.8399	NS
B/A x E	20	147.0940	7.3547	1.8080	.05
B/A x DE	40	208.8803	5.2220	1.2837	.05
B/A x C/DE	1440	5857.7435	4.0678		
TOT.	1871	11926.4786			

A,4 B,10 C,13 D,3 E,2

A = Artists
B = Slides
C = Subjects
D = Levels of Information (Label, Label-plus-rule, Control)
E = Active-Passive (Feedback, No Feedback)

ANOVA 1: Aesthetic Preference d_m Analysis

Summary Table

Source	df	SS	MS	F	P
Between					
D	2	13.5743	6.7871	26.7841	.001
E	1	0.5466	0.5466	2.1570	NS (.20)
DE	2	3.7494	1.8747	7.3981	.005
C/DE	48	12.1670	0.2534		
Within					
A	2	27.6328	13.8164	148.8836	.001
AD	4	2.9300	0.7325	7.9224	.001
AE	2	0.7023	0.3511	3.7834	.05
ADE	4	1.6629	0.4157	4.4795	.005
A x C/DE	96	8.9098	0.0928		
B/A	15	50.0010	3.3334		
B/A x D	30	6.7833	0.2261	4.1870	.001
B/A x E	15	5.5186	0.3679	6.8129	.001
B/A x DE	30	8.3718	0.2790	5.1666	.001
B/A x C/DE	720	38.8849	0.0540		
TOT.	971	181.4361			

A,3 B,10 C,9 D,3 E,2

A = Artists
B = Slides
C = Certainty-of-response Levels
D = Levels of Information (Label, Label-plus-rule, Control)
E = Active-Passive (Feedback, No Feedback)

ANOVA 1: Aesthetic Preference: Comparisons of Four Mean Ratings Analyses with Different Subjects Summary Tables

Source	df	F	P	F	P	F	P	F	P
Between									
D	2	2.0534	NS	1.6958	NS	1.2095	NS	1.6888	NS
E	1	0.7277	NS	0.1711	NS	0.2515	NS	1.5046	NS
DE	2	1.3554	NS	2.0297	NS	0.4668	NS	1.8787	NS
Within									
A	3	17.8676	.001	58.6990	.001	22.8047	.001	20.5767	.001
AD	6	2.4300	.025	9.5587	.001	2.5082	.05	2.1182	.05
AE	3	1.3643	NS	0.9141	NS	0.5155	NS	3.0727	NS
ADE	6	0.4894	NS	3.7216	.005	0.9336	NS	5.8104	.001
B/A x D	40	0.8399	NS	1.0148	.05	0.6927	NS	0.8190	NS
B/A x E	20	1.8080	.05	1.5676	.05	1.2200	NS	2.0492	.025
B/A x DE	40	1.2837	.05	1.1531	.05	1.4440	.05	1.3343	.05

A = Artists
B = Slides
C = Subjects
D = Levels of Information
E = Active-Passive

Elicited Relevant Attributes: Analysis of Variance
Summary Table

Source	df	SS	MS	F	P
A	1	0.11	0.11	0.01	NS
B	2	63.56	31.78	2.99	.10
AB	2	18.24	9.12	0.85	NS
S(AB)	72	764.08	10.61		
TOT.	77	845.99			

S_{78} $(A_2$ $B_3)$

A = Active-Passive (Feedback, No Feedback)

B = Levels of Information (Label, Label-plus-rule, Control)

APPENDIX B

LISTINGS OF CUMULATIVE PROBABILITIES BASED ON TRADITIONAL CUMULATIVE FREQUENCIES

Immediate Concept Generalization: Cumulative Probabilities Based on Average Traditional Cumulative Frequencies (Accumulated from 0 to 9) Used to Plot Graphs in Appendix C

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 1: Label:												
0	5	.25	.02	20	1.00	.10	22	1.10	.11	60	3.00	.30
1	12	.85	.08	27	2.35	.23	21	2.15	.21	34	4.70	.47
2	8	1.25	.13	21	3.40	.34	33	3.80	.38	43	6.85	.68
3	11	1.80	.18	21	4.45	.44	21	4.85	.48	22	7.95	.79
4	23	2.95	.29	23	5.60	.56	21	5.90	.59	27	9.30	.93
5	21	4.00	.40	21	6.65	.66	29	7.35	.73	5	9.55	.95
6	11	4.55	.45	22	7.75	.77	17	8.20	.82	3	9.70	.97
7	27	5.90	.59	20	8.75	.88	17	9.05	.90	3	9.85	.98
8	43	8.05	.80	19	9.70	.97	13	9.70	.97	3	10.00	1.00
9	39	10.00	1.00	6	10.00	1.00	6	10.00	1.00	0	10.00	1.00
Group 2: Label-Plus-Rule:												
0	17	.85	.08	69	3.45	.34	38	1.90	.19	84	4.20	.42
1	9	1.30	.13	26	4.75	.47	22	3.00	.30	30	5.70	.57
2	16	2.10	.21	19	5.70	.57	21	4.05	.40	32	7.30	.73
3	11	2.65	.26	12	6.30	.63	14	4.75	.47	14	8.00	.80
4	13	3.30	.33	10	6.80	.68	23	5.90	.59	15	8.75	.88
5	13	3.95	.39	17	7.65	.76	15	6.65	.66	8	9.15	.91
6	12	4.55	.45	8	8.05	.80	10	7.15	.71	1	9.20	.92
7	20	5.55	.55	11	8.60	.86	21	8.20	.82	9	9.65	.96
8	35	7.30	.73	17	9.45	.94	19	9.15	.91	5	9.90	.99
9	54	10.00	1.00	11	10.00	1.00	17	10.00	1.00	2	10.00	1.00

Immediate Concept Generalization--Continued

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 3: Exposure-Control:												
0	6	.30	.03	12	.60	.06	13	.65	.06	4	.20	.02
1	11	.85	.08	8	1.00	.10	3	.80	.08	4	.40	.04
2	16	1.65	.16	13	1.65	.16	20	1.80	.18	14	1.10	.11
3	22	2.75	.27	14	2.35	.23	17	2.65	.26	9	1.55	.15
4	89	7.20	.72	68	5.75	.57	78	6.55	.65	86	5.85	.58
5	48	9.60	.96	63	8.90	.89	51	9.10	.91	60	8.85	.88
6	3	9.75	.97	11	9.45	.94	12	9.70	.97	11	9.40	.94
7	3	9.90	.99	7	9.80	.98	4	9.90	.99	8	9.80	.98
8	1	9.95	.99	2	9.90	.99	1	9.95	.99	2	9.90	.99
9	1	10.00	1.00	2	10.00	1.00	1	10.00	1.00	2	10.00	1.00
Group 4: Label:												
0	12	.60	.06	38	1.90	.19	40	2.00	.20	80	4.00	.40
1	9	1.05	.10	22	3.00	.30	17	2.85	.28	25	5.25	.52
2	13	1.70	.17	29	4.45	.44	36	4.65	.46	39	7.20	.72
3	13	2.35	.23	20	5.45	.54	17	5.50	.55	19	8.15	.81
4	20	3.35	.33	14	6.15	.61	21	6.55	.65	13	8.80	.88
5	21	4.40	.44	20	7.15	.71	21	7.60	.76	11	9.35	.93
6	21	5.45	.54	17	8.00	.80	11	8.15	.81	5	9.60	.96
7	31	7.00	.70	21	9.03	.90	18	9.05	.90	3	9.75	.97
8	28	8.40	.84	11	9.60	.96	12	9.65	.96	4	9.95	.99
9	32	10.00	1.00	8	10.00	1.00	7	10.00	1.00	1	10.00	1.00

Immediate Concept Generalization--Continued

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 5: Label-Plus-Rule:												
0	24	1.20	.12	95	4.75	.47	89	4.45	.44	140	7.00	.70
1	8	1.60	.16	17	5.60	.56	17	5.30	.53	19	7.95	.79
2	16	2.40	.24	20	6.60	.66	19	6.25	.62	24	9.15	.91
3	7	2.75	.27	10	7.10	.71	10	6.75	.67	7	9.50	.95
4	11	3.30	.33	12	7.70	.77	17	7.60	.76	2	9.60	.96
5	8	3.70	.37	10	8.20	.82	7	7.95	.79	2	9.70	.97
6	9	4.15	.41	5	8.45	.84	3	8.10	.81	1	9.75	.97
7	19	5.10	.51	14	9.15	.91	12	8.70	.87	0	9.75	.97
8	35	6.85	.68	10	9.65	.96	19	9.65	.96	4	9.95	.99
9	63	10.00	1.00	7	10.00	1.00	7	10.00	1.00	1	10.00	1.00
Group 6: Exposure-Control:												
0	20	1.00	.10	18	.90	.09	16	.80	.08	17	.85	.08
1	1	1.05	.10	5	1.15	.11	6	1.10	.11	5	1.10	.11
2	14	1.75	.17	16	1.95	.19	24	2.30	.23	12	1.70	.17
3	26	3.05	.30	31	3.50	.35	24	3.50	.35	32	3.30	.33
4	70	6.55	.65	46	5.80	.58	60	6.50	.65	69	6.75	.67
5	44	8.76	.88	53	8.45	.84	48	8.90	.89	48	9.15	.91
6	15	9.50	.95	16	9.25	.92	13	9.55	.95	6	9.45	.94
7	4	9.70	.97	8	9.65	.96	6	9.85	.98	9	9.90	.99
8	2	9.80	.98	2	9.75	.97	1	9.90	.99	0	9.90	.99
9	4	10.00	1.00	5	10.00	1.00	2	10.00	1.00	2	10.00	1.00

f = frequency; cf = cumulative frequency; cp = cumulative probability.

Concept Retention and Delayed Generalization, Combined Data: Cumulative Probabilities Based on Average Traditional Cumulative Frequencies (Accumulated from 0 to 9) Used to Plot Graphs in Appendix C

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 1 (n = 17): Label:												
0	7	.41	.07	20	1.18	.20	20	1.18	.20	36	2.12	.35
1	1	.47	.08	9	1.71	.20	12	1.88	.31	7	2.53	.42
2	7	.88	.15	5	2.00	.33	9	2.41	.40	14	3.35	.56
3	5	1.18	.20	12	2.71	.45	12	3.12	.52	14	4.18	.70
4	9	1.71	.28	13	3.47	.58	16	4.06	.68	9	4.71	.78
5	11	2.35	.39	12	4.18	.70	15	4.94	.82	5	5.00	.83
6	12	3.06	.51	12	4.88	.81	6	5.29	.88	6	5.35	.89
7	12	3.76	.63	12	5.59	.93	4	5.53	.92	5	5.56	.94
8	19	4.88	.81	5	5.88	.98	6	5.88	.98	1	5.71	.95
9	19	6.00	1.00	2	6.00	1.00	2	6.00	1.00	5	6.00	1.00
Group 2 (n = 14): Label-Plus-Rule:												
0	8	.57	.10	24	1.71	.29	28	2.00	.33	32	2.29	.38
1	2	.71	.12	4	2.00	.33	10	2.71	.45	8	2.86	.48
2	3	.93	.15	8	2.57	.43	8	3.29	.55	8	3.43	.57
3	2	1.07	.18	4	2.86	.48	4	3.57	.60	8	4.00	.67
4	5	1.43	.24	10	3.57	.60	15	4.64	.77	5	4.36	.73
5	11	2.21	.37	7	4.07	.68	5	5.00	.83	9	5.00	.83
6	6	2.64	.44	8	4.64	.77	1	5.07	.85	2	5.14	.86
7	14	3.64	.61	11	5.43	.90	7	5.57	.93	4	5.43	.90
8	8	4.21	.70	4	5.71	.95	5	5.93	.99	8	6.00	1.00
9	25	6.00	1.00	4	6.00	1.00	1	6.00	1.00	0	6.00	1.00

Concept Retention and Delayed Generalization--Continued

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 3 (n = 18): Exposure-Control:												
0	0	0.00	0.00	5	.28	.05	2	.11	.02	3	.17	.03
1	1	.06	.01	2	.39	.06	4	.33	.06	3	.33	.06
2	3	.22	.04	5	.67	.11	3	.50	.08	8	.78	.13
3	10	.78	.13	11	1.28	.21	10	1.06	.18	7	1.17	.19
4	48	3.44	.57	38	3.39	.56	44	3.50	.58	50	3.94	.66
5	32	5.22	.87	37	5.44	.91	33	5.33	.89	29	5.56	.93
6	3	5.39	.90	4	5.67	.94	8	5.78	.96	5	5.83	.97
7	6	5.72	.95	3	5.83	.97	3	5.94	.99	2	5.94	.99
8	5	6.00	1.00	0	5.83	.97	1	6.00	1.00	1	6.00	1.00
9	0	6.00	1.00	3	6.00	1.00	0	6.00	1.00	0	6.00	1.00
Group 4 (n = 20): Label:												
0	4	.20	.03	20	1.00	.17	25	1.25	.21	40	2.00	.33
1	1	.25	.04	8	1.40	.23	14	1.95	.32	19	2.95	.49
2	5	.50	.08	10	1.90	.32	21	3.00	.50	16	3.75	.63
3	7	.85	.14	10	2.40	.40	8	3.40	.57	6	4.05	.67
4	13	1.50	.25	19	3.35	.56	25	4.65	.77	16	4.85	.81
5	23	2.65	.44	15	4.10	.68	11	5.20	.87	8	5.25	.88
6	9	3.10	.52	5	5.35	.72	5	5.45	.91	5	5.50	.92
7	14	3.80	.63	13	5.00	.83	3	5.60	.93	3	5.56	.94
8	17	4.65	.77	9	5.45	.91	5	5.85	.97	2	5.75	.96
9	27	6.00	1.00	11	6.00	1.00	3	6.00	1.00	5	6.00	1.00

Concept Retention and Delayed Generalization--Continued

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 5 (n = 15): Label-Plus-Rule:												
0	3	.20	.03	36	2.40	.40	44	2.93	.49	57	3.80	.63
1	3	.40	.07	9	3.00	.50	8	3.47	.58	4	4.07	.68
2	3	.60	.10	10	3.67	.61	10	4.13	.69	6	4.47	.74
3	1	.67	.11	1	3.73	.62	8	4.67	.78	0	4.47	.74
4	4	.93	.16	8	4.27	.71	3	4.87	.81	6	4.87	.81
5	5	1.27	.21	3	4.47	.74	7	5.33	.89	3	5.07	.84
6	6	1.67	.28	1	4.53	.76	3	5.53	.92	5	5.40	.90
7	5	2.00	.33	4	4.80	.80	1	5.60	.93	4	5.67	.94
8	14	2.93	.49	8	5.33	.89	4	5.87	.98	1	5.73	.96
9	46	6.00	1.00	10	6.00	1.00	2	6.00	1.00	4	6.00	1.00
Group 6 (n = 13): Exposure-Control:												
0	6	.46	.08	11	.85	.14	7	.54	.09	6	.46	.08
1	0	.46	.08	0	.85	.14	2	.69	.12	4	.77	.13
2	2	.62	.10	4	1.15	.19	4	1.00	.17	3	1.00	.17
3	10	1.38	.23	5	1.54	.26	10	1.77	.29	10	1.77	.29
4	34	4.00	.67	31	3.92	.65	28	3.92	.65	32	4.23	.71
5	16	5.23	.87	21	5.54	.92	26	5.92	.99	22	5.92	.99
6	5	5.62	.94	5	5.92	.99	1	6.00	1.00	0	5.92	.99
7	1	5.69	.95	0	5.92	.99	0	6.00	1.00	0	5.92	.99
8	1	5.77	.96	0	5.92	.99	0	6.00	1.00	0	5.92	.99
9	3	6.00	1.00	1	6.00	1.00	0	6.00	1.00	1	6.00	1.00

f = frequency; cf = cumulative frequency; cp = cumulative probability.

Concept Retention: Cumulative Probabilities Based on Average Traditional Cumulative Frequencies (Accumulated from 0 to 9) Used to Plot Graphs in Appendix C

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 1: Label:												
0	5	1.66	.09	11	3.66	.21	10	3.33	.19	22	7.33	.43
1	0	1.66	.09	2	4.33	.25	4	4.66	.27	3	8.33	.49
2	3	2.66	.15	2	5.00	.29	5	6.33	.37	7	10.66	.62
3	2	3.33	.19	6	7.00	.41	8	9.00	.52	8	13.33	.78
4	5	5.00	.29	5	8.66	.50	5	10.66	.62	3	14.33	.84
5	4	6.33	.37	6	10.66	.62	9	13.66	.80	2	15.00	.88
6	5	8.00	.47	8	13.33	.78	4	15.00	.88	2	15.66	.92
7	7	10.33	.60	5	15.00	.88	1	15.33	.90	0	15.66	.92
8	10	13.66	.80	4	16.33	.96	4	16.66	.98	0	15.66	.92
9	10	17.00	1.00	2	17.00	1.00	1	17.00	1.00	4	17.00	1.00
Group 2: Label-Plus-Rule:												
0	4	1.33	.09	15	5.00	.35	14	4.66	.33	21	7.00	.50
1	2	2.00	.14	1	5.33	.38	4	6.00	.42	2	7.66	.54
2	2	2.66	.19	2	6.00	.42	5	7.66	.54	4	9.00	.64
3	1	3.00	.21	2	6.66	.47	1	8.00	.57	4	10.33	.73
4	2	3.66	.26	4	8.00	.57	7	10.33	.73	3	11.33	.80
5	6	5.66	.40	4	9.33	.66	3	11.33	.80	2	12.00	.85
6	1	6.00	.42	2	10.00	.71	1	11.66	.83	0	12.00	.85
7	9	9.00	.64	8	12.66	.90	4	13.00	.92	1	12.33	.88
8	3	10.00	.71	2	13.33	.95	2	13.66	.97	5	14.00	1.00
9	12	14.00	1.00	2	14.00	1.00	1	14.00	1.00	0	14.00	1.00

Concept Retention--Continued

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 3: Exposure:												
0	0	0.00	0.00	4	1.33	.07	1	.33	.01	2	.66	.03
1	0	0.00	0.00	0	1.33	.07	3	1.33	.07	2	1.33	.07
2	1	.33	.01	3	2.33	.12	2	2.00	.11	4	2.66	.14
3	9	3.33	.18	3	3.33	.18	4	3.33	.18	4	4.00	.22
4	18	9.33	.51	19	9.66	.53	20	10.00	.55	23	11.66	.64
5	19	15.66	.87	20	16.33	.90	18	16.00	.88	16	17.00	.94
6	2	16.33	.90	3	17.33	.96	5	17.66	.98	2	17.66	.98
7	3	17.33	.96	2	18.00	1.00	1	18.00	1.00	0	17.66	.98
8	2	18.00	1.00	0	18.00	1.00	0	18.00	1.00	1	18.00	1.00
9	0	18.00	1.00	0	18.00	1.00	0	18.00	1.00	0	18.00	1.00
Group 4: Label:												
0	3	1.00	.05	11	3.66	.18	15	5.00	.25	23	7.66	.38
1	1	1.33	.06	3	4.66	.23	5	6.66	.33	11	11.33	.56
2	2	2.00	.10	5	6.33	.31	11	10.33	.51	8	14.00	.70
3	3	3.00	.15	3	7.33	.36	5	12.00	.60	5	15.66	.78
4	6	5.00	.25	7	9.66	.48	12	16.00	.80	7	18.00	.90
5	12	9.00	.45	8	12.33	.61	5	17.66	.88	2	18.66	.93
6	4	10.33	.51	2	13.00	.65	2	18.33	.91	1	19.00	.95
7	8	13.00	.65	10	16.33	.81	1	18.66	.93	1	19.33	.96
8	6	15.00	.75	5	18.00	.90	1	19.00	.95	0	19.33	.96
9	15	20.00	1.00	6	20.00	1.00	3	20.00	1.00	2	20.00	1.00

Concept Retention--Continued

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 5: Label-Plus-Rule:												
0	2	.66	.04	21	7.00	.46	23	7.66	.51	31	10.33	.68
1	1	1.00	.06	3	8.00	.53	4	9.00	.60	2	11.00	.73
2	3	2.00	.13	3	9.00	.60	3	10.00	.66	4	12.33	.82
3	1	2.33	.15	0	9.00	.60	3	11.00	.73	0	12.33	.82
4	2	3.00	.20	2	9.66	.64	2	11.66	.77	3	13.33	.88
5	2	3.66	.24	2	10.33	.68	4	13.00	.86	0	13.33	.88
6	3	4.66	.31	1	10.66	.71	1	13.33	.88	3	14.33	.95
7	3	5.66	.37	3	11.66	.77	1	13.66	.91	0	14.33	.95
8	8	8.33	.55	5	13.33	.88	3	14.66	.97	0	14.33	.95
9	20	15.00	1.00	5	15.00	1.00	1	15.00	1.00	2	15.00	1.00
Group 6: Exposure-Control:												
0	3	1.00	.07	9	3.00	.23	5	1.66	.12	1	.33	.02
1	0	1.00	.07	0	3.00	.23	1	2.00	.15	2	1.00	.07
2	0	1.00	.07	1	3.33	.25	2	2.66	.20	1	1.33	.10
3	7	3.33	.25	0	3.33	.25	3	3.66	.28	3	2.33	.17
4	14	8.00	.61	12	7.33	.56	13	8.00	.61	16	7.66	.58
5	10	11.33	.87	13	11.66	.89	15	13.00	1.00	15	12.66	.97
6	2	12.00	.92	4	13.00	1.00	0	13.00	1.00	0	12.66	.97
7	0	12.00	.92	0	13.00	1.00	0	13.00	1.00	0	12.66	.97
8	1	12.33	.94	0	13.00	1.00	0	13.00	1.00	0	12.66	.97
9	2	13.00	1.00	0	13.00	1.00	0	13.00	1.00	1	13.00	1.00

f = frequency; cf = cumulative frequency; cp = cumulative probability.

Delayed Generalization: Cumulative Probabilities Based on Average Traditional Cumulative Frequencies (Accumulated from 0 to 9) Used to Plot Graphs in Appendix C

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 1: Label:												
0	2	.66	.03	9	3.00	.17	9	3.00	.17	14	4.66	.27
1	1	1.00	.05	7	5.33	.31	8	5.66	.33	4	6.00	.35
2	4	2.33	.13	3	6.33	.37	4	7.00	.41	7	8.33	.49
3	3	3.33	.19	6	8.33	.49	4	8.33	.49	6	10.33	.60
4	3	4.33	.25	8	11.00	.64	12	12.33	.72	6	12.33	.72
5	7	6.66	.39	6	13.00	.76	6	14.33	.84	3	13.33	.78
6	7	9.00	.52	4	14.33	.84	2	15.00	.88	4	14.66	.86
7	5	10.66	.62	7	16.66	.98	3	16.00	.94	5	16.33	.96
8	10	14.00	.82	1	17.00	1.00	2	16.66	.98	1	16.66	.98
9	9	17.00	1.00	0	17.00	1.00	1	17.00	1.00	1	17.00	1.00
Group 2: Label-Plus-Rule:												
0	4	1.33	.09	9	3.00	.21	14	4.66	.33	11	3.66	.26
1	0	1.33	.09	3	4.00	.28	6	6.66	.47	6	5.66	.40
2	1	1.66	.11	6	6.00	.42	3	7.66	.54	4	7.00	.50
3	1	2.00	.14	2	6.66	.47	3	8.66	.61	4	8.33	.59
4	3	3.00	.21	6	8.66	.61	8	11.33	.80	2	9.00	.64
5	5	4.66	.33	3	9.66	.69	2	12.00	.85	7	11.33	.80
6	5	6.33	.45	6	11.66	.83	0	12.00	.85	2	12.00	.85
7	5	8.00	.57	3	12.66	.90	3	13.00	.92	3	13.00	.92
8	5	9.66	.69	2	13.33	.95	3	14.00	1.00	3	14.00	1.00
9	13	14.00	1.00	2	14.00	1.00	0	14.00	1.00	0	14.00	1.00

Delayed Generalization--Continued

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 3: Exposure:												
0	0	0.00	0.00	1	.33	.01	1	.33	.01	1	.33	.01
1	1	.33	.01	2	1.00	.05	1	.66	.03	1	.66	.03
2	2	1.00	.05	2	1.66	.09	1	1.00	.05	4	2.00	.11
3	1	1.33	.07	8	4.33	.24	6	3.00	.16	3	3.00	.16
4	30	11.33	.62	19	10.66	.59	24	11.00	.61	28	12.33	.68
5	13	15.66	.87	17	16.33	.90	15	16.00	.88	12	16.33	.90
6	1	16.00	.88	1	16.66	.92	3	17.00	.94	3	17.33	.96
7	3	17.00	.94	1	17.00	.94	2	17.66	.98	2	18.00	1.00
8	3	18.00	1.00	0	17.00	.94	1	18.00	1.00	0	18.00	1.00
9	0	18.00	1.00	3	18.00	1.00	0	18.00	1.00	0	18.00	1.00
Group 4: Label:												
0	1	.33	.01	9	3.00	.15	10	3.33	.16	17	5.66	.28
1	0	.33	.01	5	4.66	.23	9	6.33	.31	8	8.33	.41
2	3	1.33	.06	5	6.33	.31	10	9.66	.48	8	11.00	.55
3	4	2.66	.13	7	8.66	.43	3	10.66	.53	1	11.33	.56
4	7	5.00	.24	12	12.66	.63	13	15.00	.75	9	14.33	.71
5	11	8.66	.43	7	15.00	.75	6	17.00	.85	6	16.33	.81
6	5	10.33	.51	3	16.00	.80	3	18.00	.90	4	17.66	.88
7	6	12.33	.61	3	17.00	.85	2	18.66	.93	2	18.33	.91
8	11	16.00	.80	4	18.33	.91	4	20.00	1.00	2	19.00	.95
9	12	20.00	1.00	5	20.00	1.00	0	20.00	1.00	3	20.00	1.00

Delayed Generalization--Continued

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 5: Label-Plus-Rule:												
0	1	.33	.02	15	5.00	.33	21	7.00	.46	26	8.66	.57
1	2	1.00	.06	6	7.00	.46	4	8.33	.55	2	9.33	.62
2	0	1.00	.06	7	9.33	.62	7	10.66	.71	2	10.00	.66
3	0	1.00	.06	1	9.60	.64	5	12.33	.82	0	10.00	.66
4	2	1.66	.11	6	11.66	.77	1	12.66	.84	3	11.00	.73
5	3	2.66	.17	1	12.00	.80	3	13.66	.91	3	12.00	.80
6	3	3.66	.24	0	12.00	.80	2	14.33	.95	2	12.66	.84
7	2	4.33	.28	1	12.33	.82	0	14.33	.95	4	14.00	.93
8	6	6.33	.42	3	13.33	.88	1	14.66	.97	1	14.33	.95
9	26	15.00	1.00	5	15.00	1.00	1	15.00	1.00	2	15.00	1.00
Group 6: Exposure-Control:												
0	3	1.00	.07	2	.66	.05	2	.66	.05	4	1.33	.10
1	0	1.00	.07	0	.66	.05	1	1.00	.07	2	2.00	.15
2	1	1.33	.10	3	1.66	.12	2	1.66	.12	3	3.00	.23
3	3	2.33	.17	5	3.33	.25	7	4.00	.30	7	5.33	.41
4	21	9.33	.71	19	9.66	.74	15	9.00	.69	15	10.33	.79
5	6	11.33	.87	8	12.33	.94	11	12.66	.97	7	12.66	.97
6	3	12.33	.94	1	12.66	.97	1	13.00	1.00	0	12.66	.97
7	1	12.66	.97	0	12.66	.97	0	13.00	1.00	0	12.66	.97
8	0	12.66	.97	0	12.66	.97	0	13.00	1.00	0	12.66	.97
9	1	13.00	1.00	1	13.00	1.00	0	13.00	1.00	1	13.00	1.00

f = frequency; cf = cumulative frequency; cp = cumulative probability.

Aesthetic Preference: Cumulative Probabilities Based on Average Traditional Cumulative Frequencies (Accumulated from 0 to 9) Used to Plot Graphs in Appendix C

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 1 (n = 17): Label:												
0	7	.41	.07	4	.24	.04	7	.41	.07	7	.41	.07
1	7	.82	.14	3	.41	.07	11	1.06	.18	13	1.18	.20
2	7	1.24	.21	6	.76	.13	7	1.47	.25	10	1.76	.29
3	6	1.59	.26	9	1.29	.22	11	2.12	.35	8	2.24	.37
4	19	2.71	.45	11	1.94	.32	22	3.41	.57	23	3.59	.60
5	15	3.59	.60	19	3.06	.51	22	4.71	.78	13	4.35	.73
6	10	4.18	.70	16	4.00	.67	13	5.47	.91	12	5.06	.84
7	16	5.12	.85	10	4.59	.76	3	5.65	.94	8	5.53	.92
8	8	5.59	.93	9	5.12	.85	5	5.94	.99	3	5.71	.95
9	7	6.00	1.00	15	6.00	1.00	1	6.00	1.00	5	6.00	1.00
Group 2 (n = 14): Label-Plus-Rule:												
0	7	.50	.08	5	.36	.06	3	.21	.04	5	.36	.06
1	4	.79	.13	0	.36	.06	5	.57	.10	7	.86	.14
2	10	1.50	.25	5	.71	.12	5	.93	.15	5	1.21	.20
3	2	1.64	.27	4	1.00	.17	12	1.79	.30	10	1.93	.32
4	9	2.29	.38	7	1.50	.25	15	2.86	.48	10	2.64	.44
5	10	3.00	.50	16	2.64	.44	18	4.14	.69	15	3.71	.62
6	9	3.64	.61	8	3.21	.54	7	4.64	.77	15	4.79	.80
7	9	4.29	.71	12	4.07	.68	3	4.86	.81	5	5.14	.86
8	11	5.07	.85	16	5.21	.87	10	5.57	.93	7	5.64	.94
9	13	6.00	1.00	11	6.00	1.00	6	6.00	1.00	5	6.00	1.00

Aesthetic Preference--Continued

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 3 (n = 18): Exposure:												
0	8	.44	.07	2	.11	.02	1	.06	.01	3	.17	.03
1	4	.67	.11	4	.33	.06	4	.28	.05	3	.33	.06
2	5	.94	.16	3	.50	.08	12	.94	.16	11	.94	.16
3	9	1.44	.24	5	.78	.13	11	1.56	.26	9	1.44	.24
4	10	2.00	.33	15	1.61	.27	19	2.61	.44	21	2.61	.44
5	31	3.72	.62	18	2.61	.44	24	3.94	.66	30	4.28	.71
6	15	4.56	.76	18	3.61	.60	10	4.50	.75	5	4.56	.76
7	11	5.17	.86	16	4.50	.75	12	5.17	.86	7	4.94	.82
8	4	5.39	.90	14	5.28	.88	6	5.50	.92	6	5.28	.88
9	11	6.00	1.00	13	6.00	1.00	9	6.00	1.00	13	6.00	1.00
Group 4 (n = 20): Exposure:												
0	7	.35	.06	6	.30	.05	12	.60	.10	23	1.15	.19
1	7	.70	.12	7	.65	.11	6	.90	.15	9	1.60	.27
2	4	.90	.15	4	.85	.14	7	1.25	.21	15	2.35	.39
3	8	1.30	.22	5	1.10	.18	11	1.80	.30	11	2.90	.48
4	15	2.05	.34	16	1.90	.32	20	2.80	.47	18	3.80	.63
5	25	3.30	.55	20	2.90	.48	28	4.20	.70	19	4.75	.79
6	15	4.05	.67	17	3.75	.63	8	4.60	.77	5	5.00	.83
7	10	4.55	.76	21	4.80	.80	9	5.05	.84	12	5.60	.93
8	17	5.40	.90	15	5.55	.92	12	5.65	.94	6	5.90	.98
9	12	6.00	1.00	9	6.00	1.00	7	6.00	1.00	2	6.00	1.00

Aesthetic Preference--Continued

Confidence Level	Artist A: Manet			Artist B: Renoir			Artist C: Degas			Artist D: Lautrec		
	f	cf	cp	f	cf	cp	f	cf	cp	f	cf	cp
Group 5 (n = 15): Label-Plus-Rule:												
0	7	.47	.08	5	.33	.06	7	.47	.08	11	.73	.12
1	0	.47	.08	3	.53	.09	2	.60	.10	7	1.20	.20
2	9	1.07	.18	1	.60	.10	4	.87	.14	3	1.40	.23
3	10	1.73	.29	5	.93	.16	6	1.27	.21	8	1.93	.32
4	12	2.53	.42	11	1.67	.28	23	2.80	.47	20	3.27	.54
5	16	3.60	.60	20	3.00	.50	21	4.20	.70	16	4.33	.72
6	16	4.67	.78	11	3.73	.62	8	4.73	.79	3	4.53	.76
7	11	5.40	.90	8	4.27	.71	11	5.47	.91	5	4.87	.81
8	4	5.67	.94	14	5.20	.87	3	5.67	.94	9	5.47	.91
9	5	6.00	1.00	12	6.00	1.00	5	6.00	1.00	8	6.00	1.00
Group 6 (n = 13): Exposure-Control:												
0	6	.46	.08	4	.31	.05	4	.31	.05	5	.38	.06
1	2	.62	.10	1	.38	.06	4	.62	.10	3	.62	.10
2	2	.77	.13	8	1.00	.17	3	.85	.14	4	.92	.15
3	7	1.31	.22	1	1.08	.18	7	1.38	.23	11	1.77	.29
4	15	2.46	.41	9	1.77	.29	18	2.77	.46	10	2.54	.42
5	18	3.85	.64	21	3.38	.56	18	4.15	.69	15	3.69	.62
6	8	4.46	.74	11	4.23	.71	8	4.77	.79	10	4.46	.74
7	9	5.15	.86	4	4.54	.67	6	5.23	.87	5	4.85	.81
8	8	5.77	.96	11	5.38	.90	8	5.85	.97	10	5.62	.94
9	3	6.00	1.00	8	6.00	1.00	2	6.00	1.00	5	6.00	1.00

f = frequency; cf = cumulative frequency; cp = cumulative probability.

APPENDIX C

GRAPHS OF TRADITIONAL CUMULATIVE PROBABILITIES

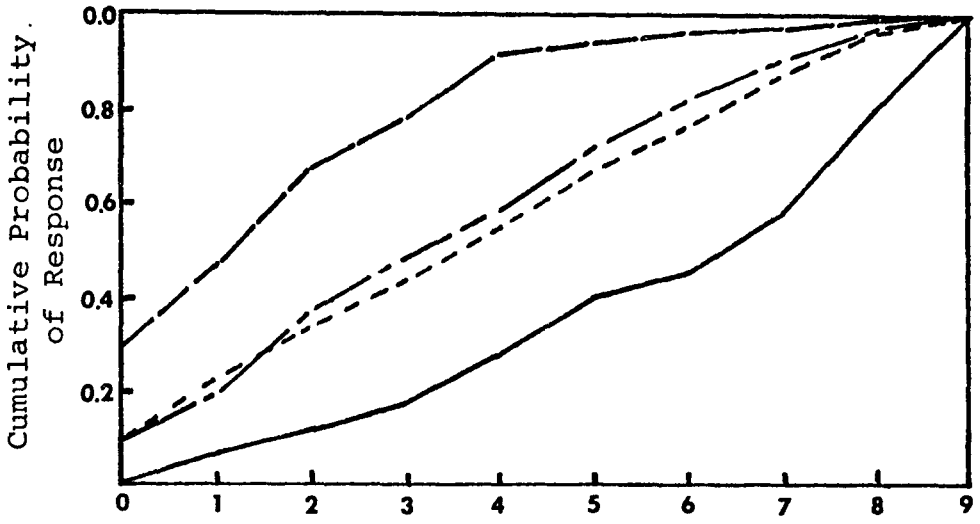
Cumulative Probability Graphs

Cumulative probability distributions of observer responses may be interpreted as an index of certainty concerning a binary decision (Wheeler et al., 1971). All training groups exhibited greater certainty of response than control groups, as measured by more frequent use of both ends of the rating scale (certain-yes and certain-no). The S-shaped curve of the control groups is characteristic of great uncertainty of response. Most of the responses cluster around the middle of the scale, with little use made of the more definite yes or no response at either end.

The experimental detection tasks required subjects to rate each painting according to their confidence that it either was, or was not, the work of Manet. All training groups clearly were confident in discriminating Manet's style of painting, as graphed by lines that bow away from the diagonal toward the lower right-hand corner. Scores at the fiftieth percentile are well into the certain-yes end of the scale. The distribution of responses for Lautrec show a dramatic shift, indicated by lines curving into the upper left-hand corner of the graph. All subjects expressed a

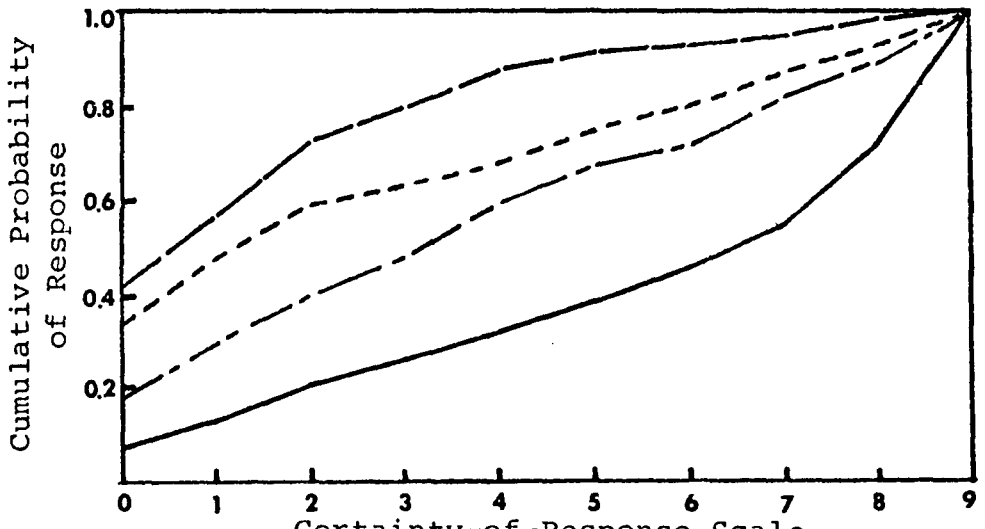
high degree of confidence in judging that Lautrec's painting style is not similar to that of Manet. Subjects' confidence that Renoir and Degas were not the target artist was not high, with the result that the majority of subjects assigned more ratings in the middle of the scale to these two artists.

Immediate Concept Generalization



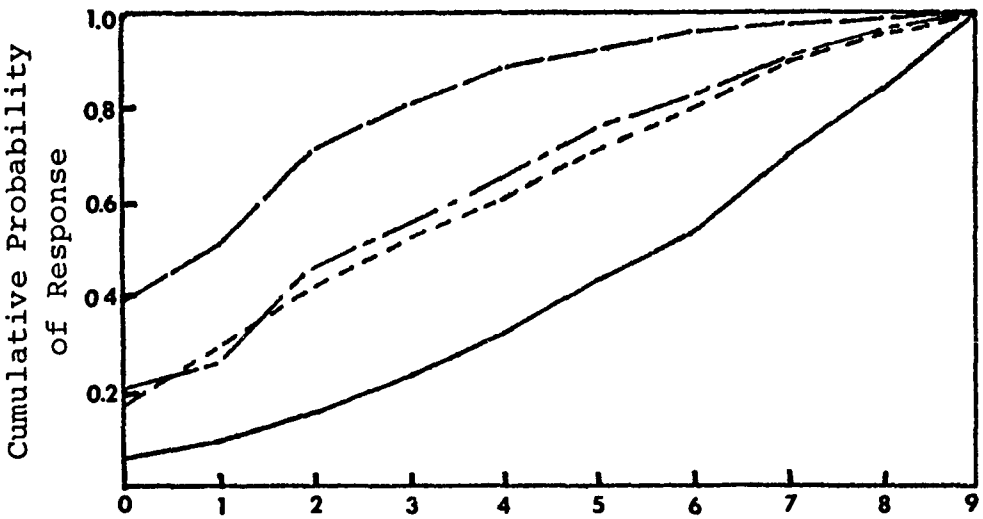
Group 1: Active label-only

Manet
Renoir
Degas
Lautrec

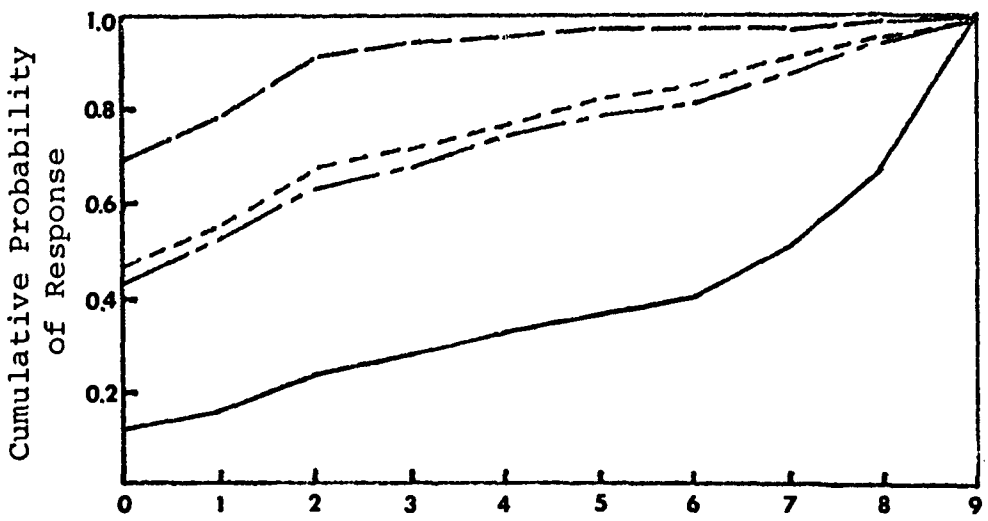


Group 2: Active label-plus-rule

Immediate Concept Generalization--Continued

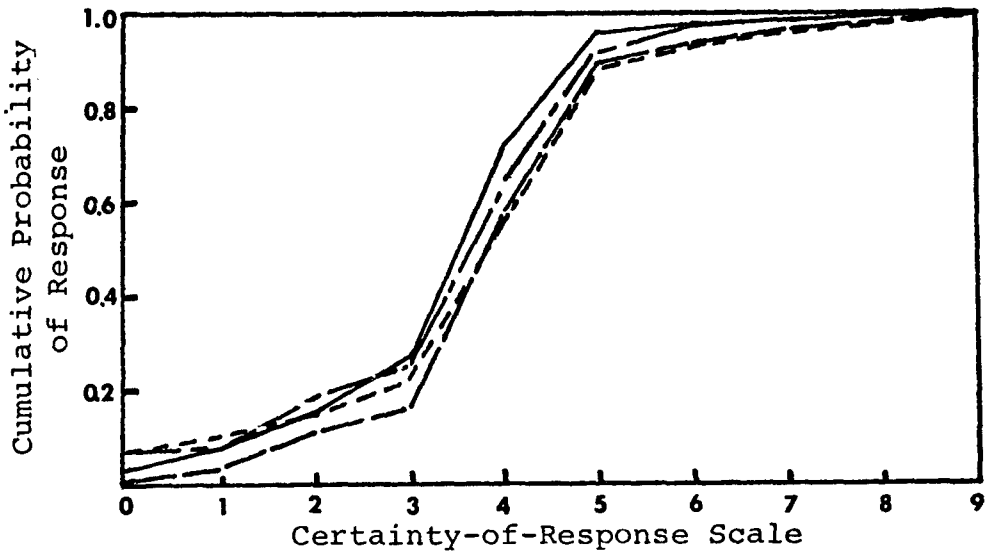


Group 4: Passive label-only

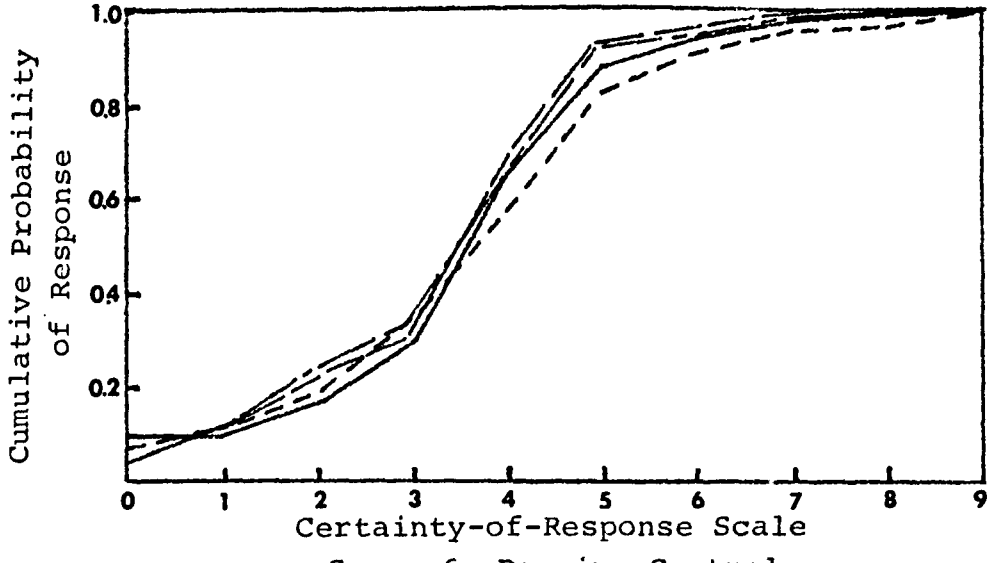


Group 5: Passive label-plus-rule

Immediate Concept Generalization--Continued

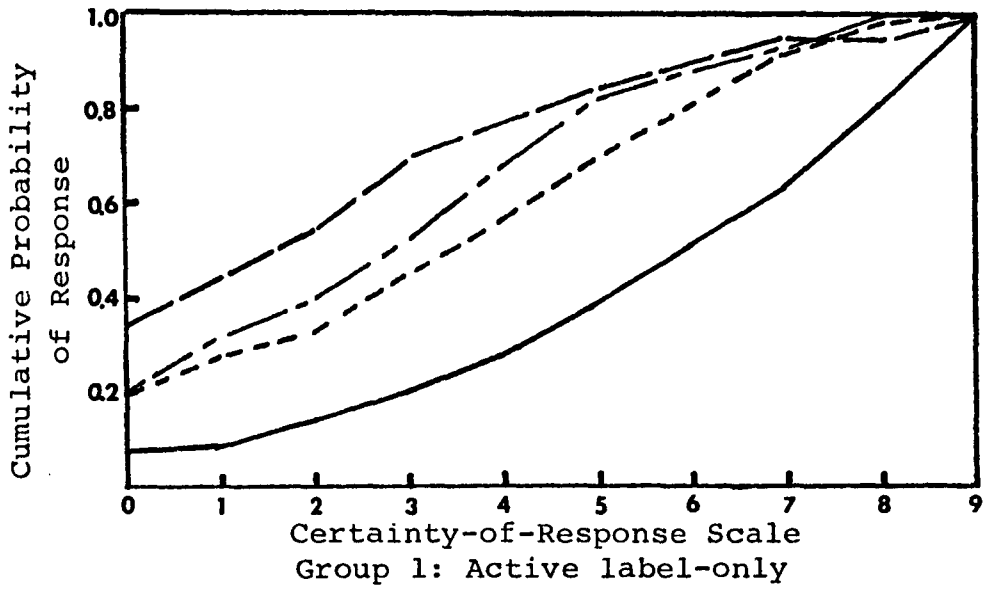


Group 3: Active Control

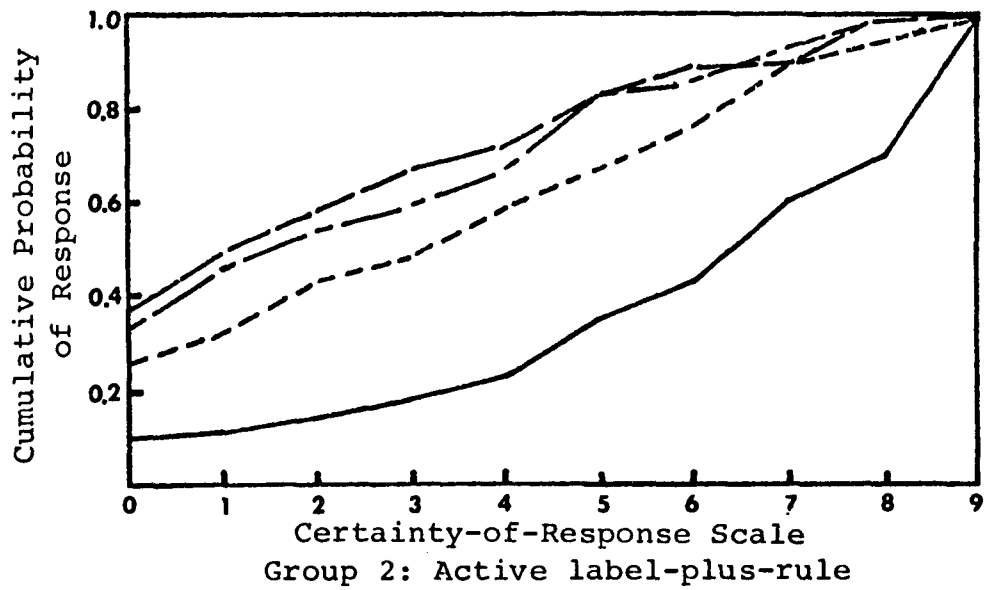


Group 6: Passive Control

Concept Retention and Delayed Generalization, Combined Data

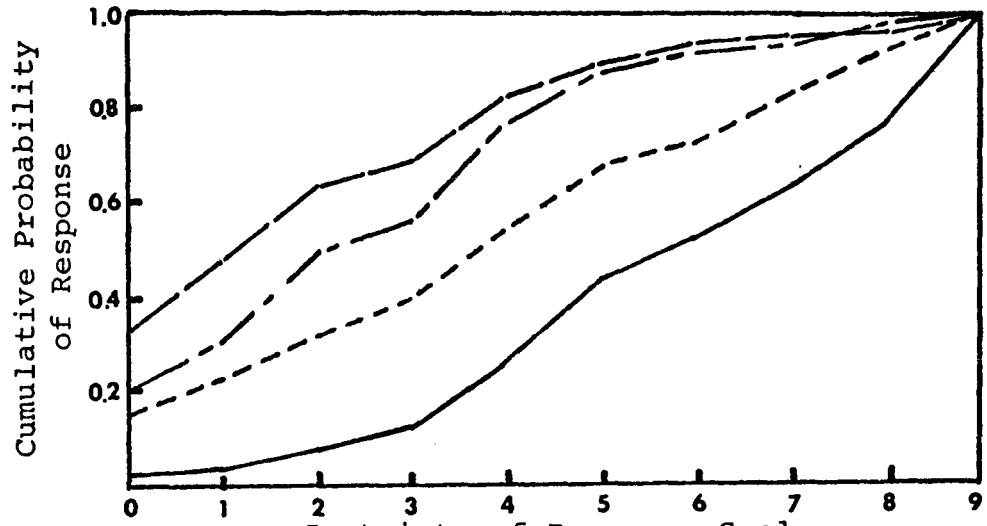


Group 1: Active label-only

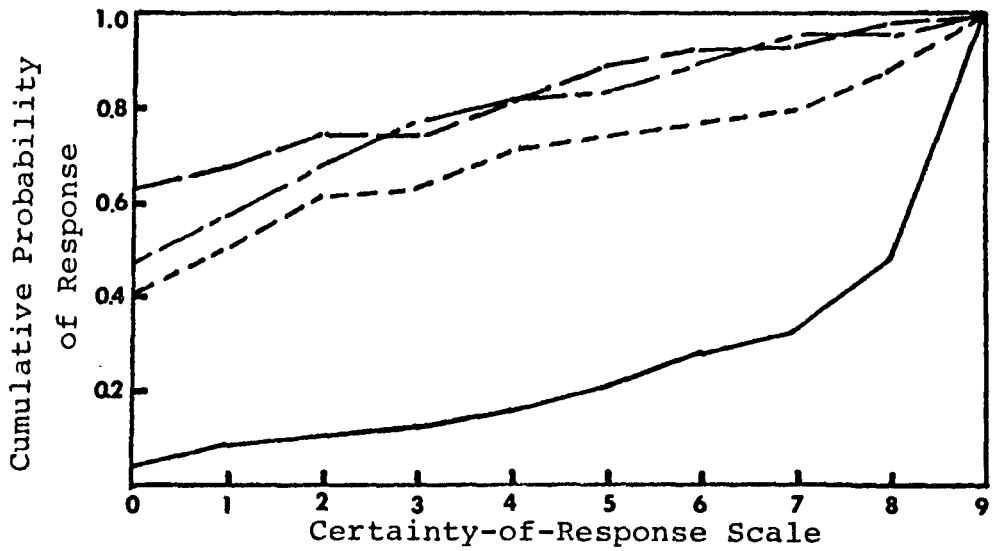


Group 2: Active label-plus-rule

Concept Retention and Delayed Generalization--Continued

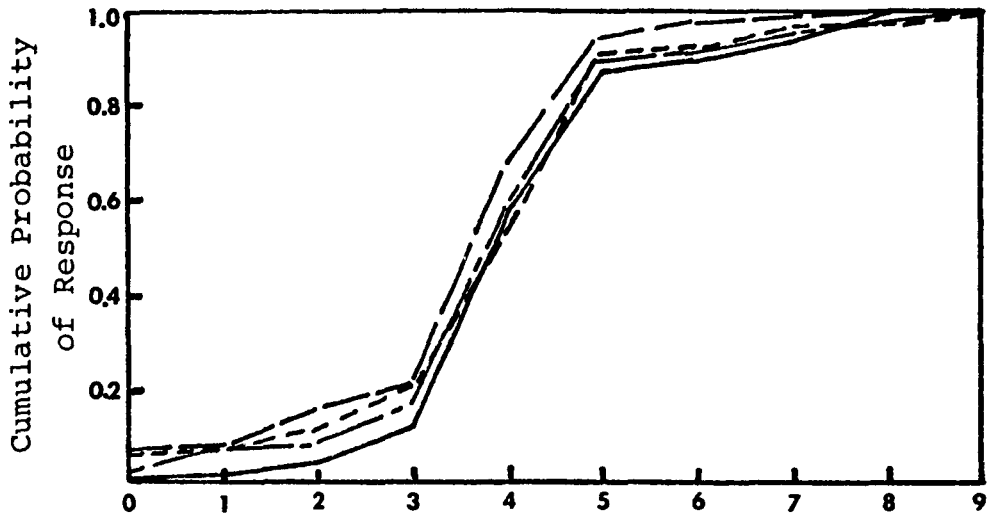


Group 4: Passive label-only

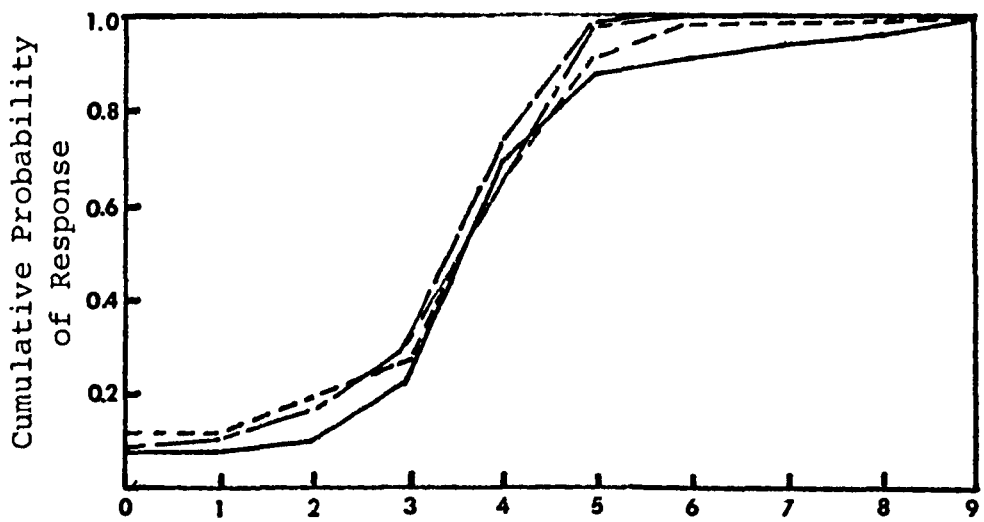


Group 5: Passive label-plus-rule

Concept Retention and Delayed Generalization--Continued

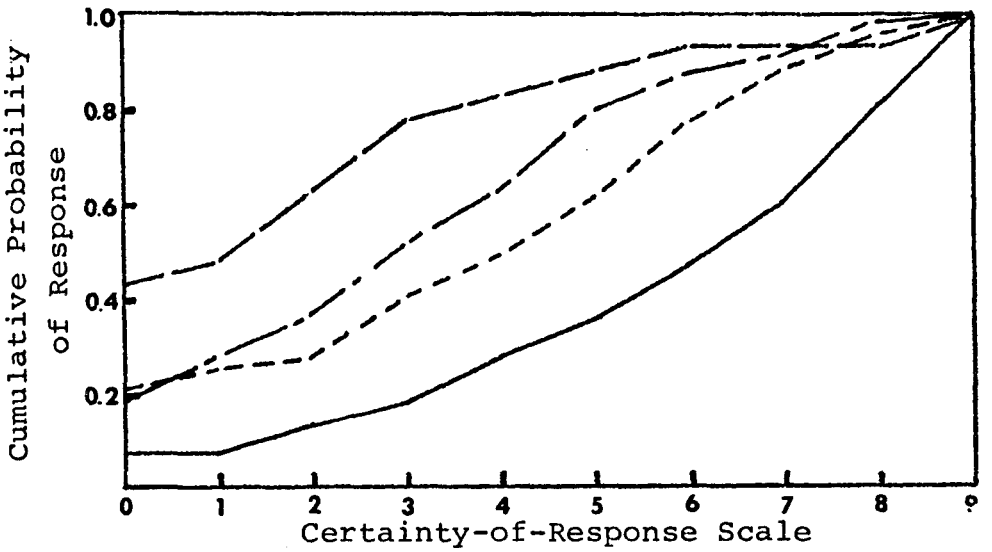


Group 3: Active Control

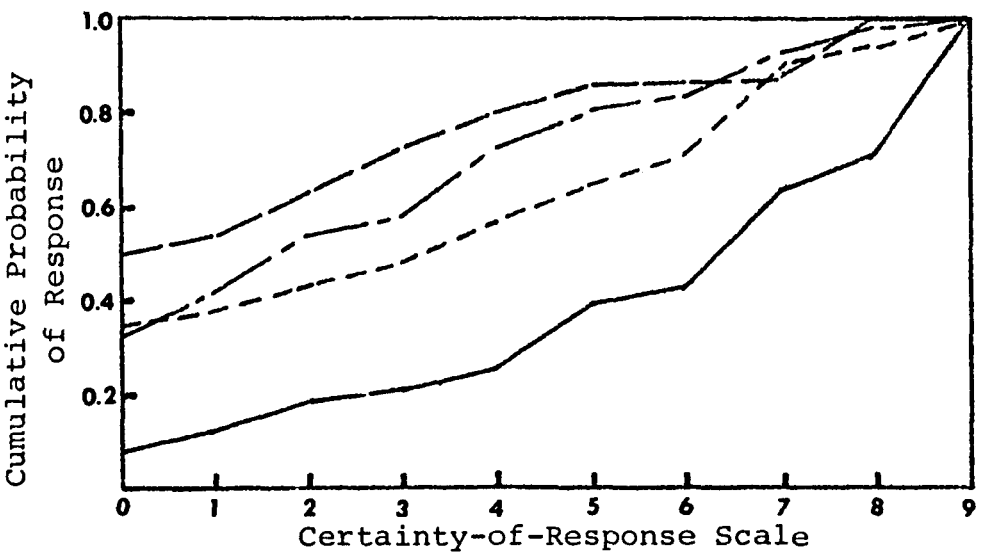


Group 6: Passive Control

Concept Retention

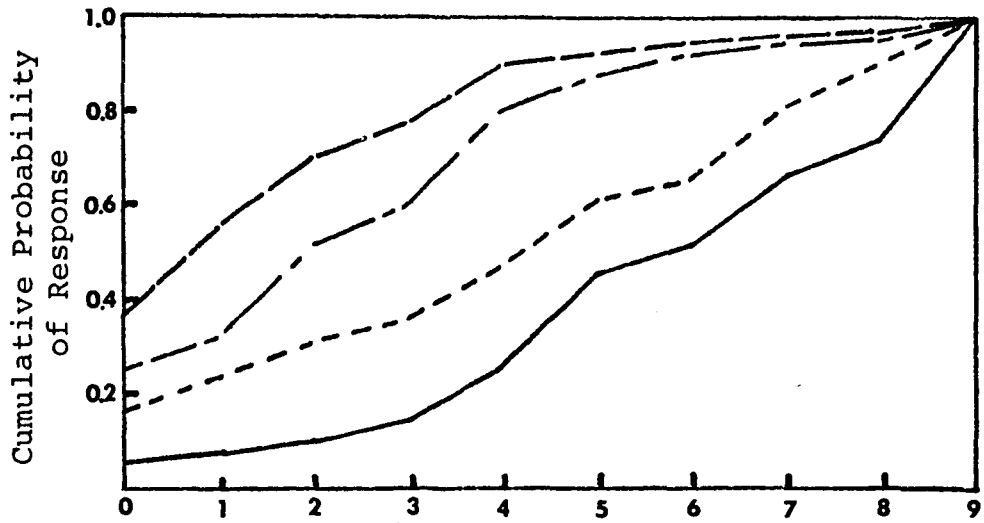


Group 1: Active label-only

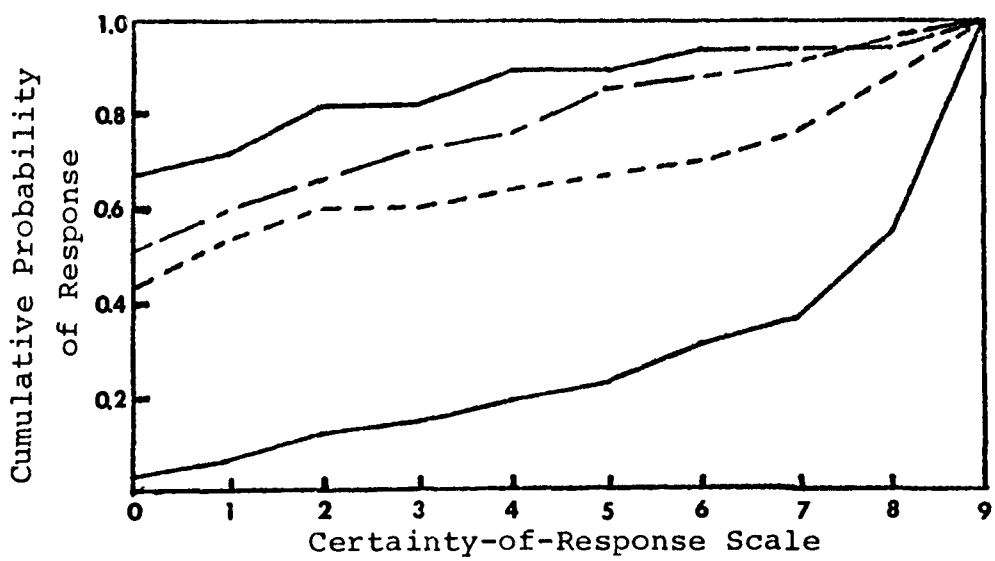


Group 2: Active label-plus-rule

Concept Retention--Continued

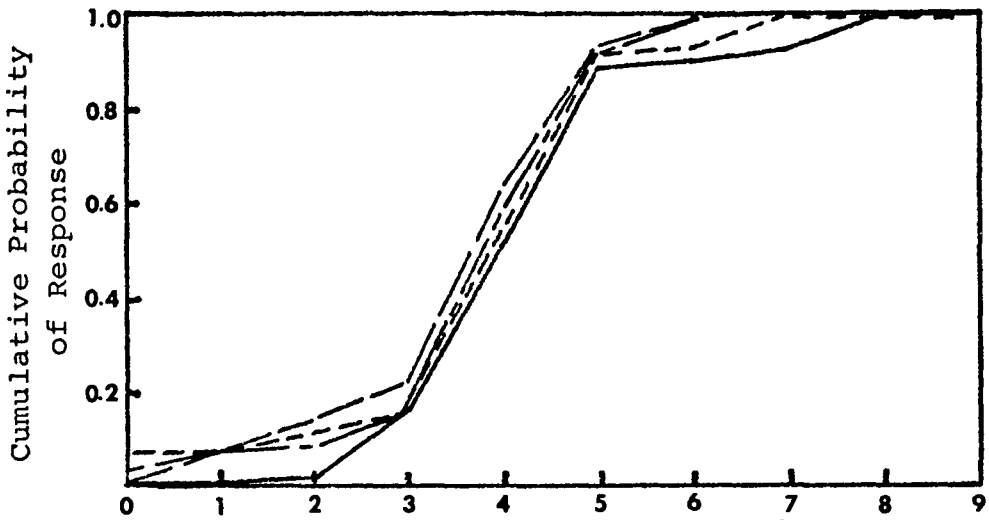


Group 4: Passive label-only

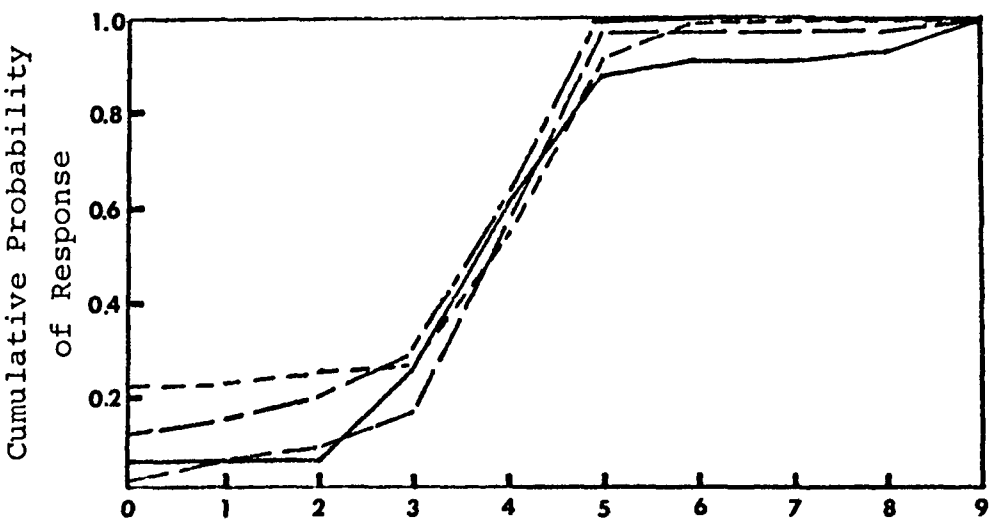


Group 5: Passive label-plus-rule

Concept Retention--Continued

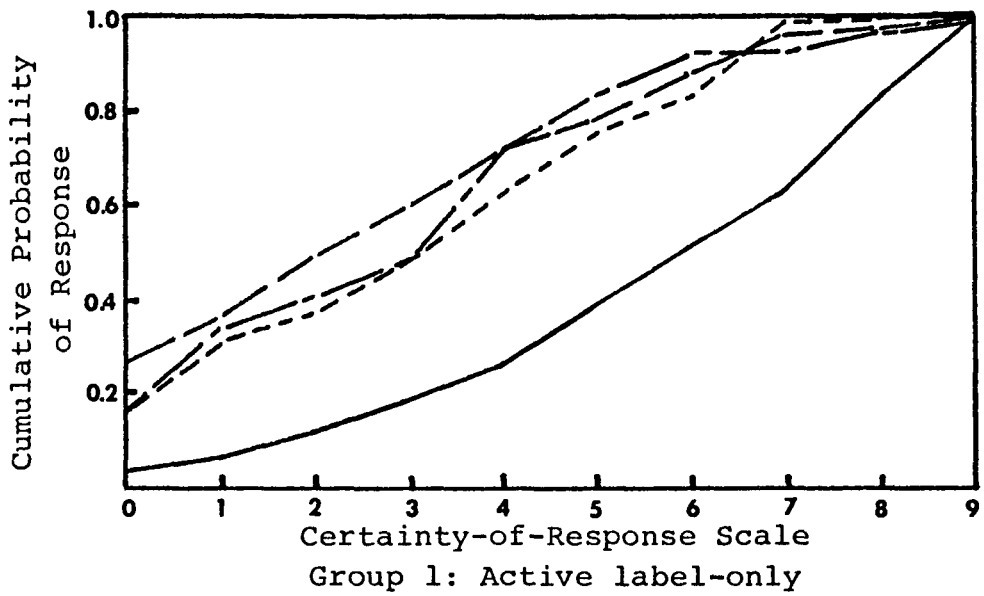


Group 3: Active Control

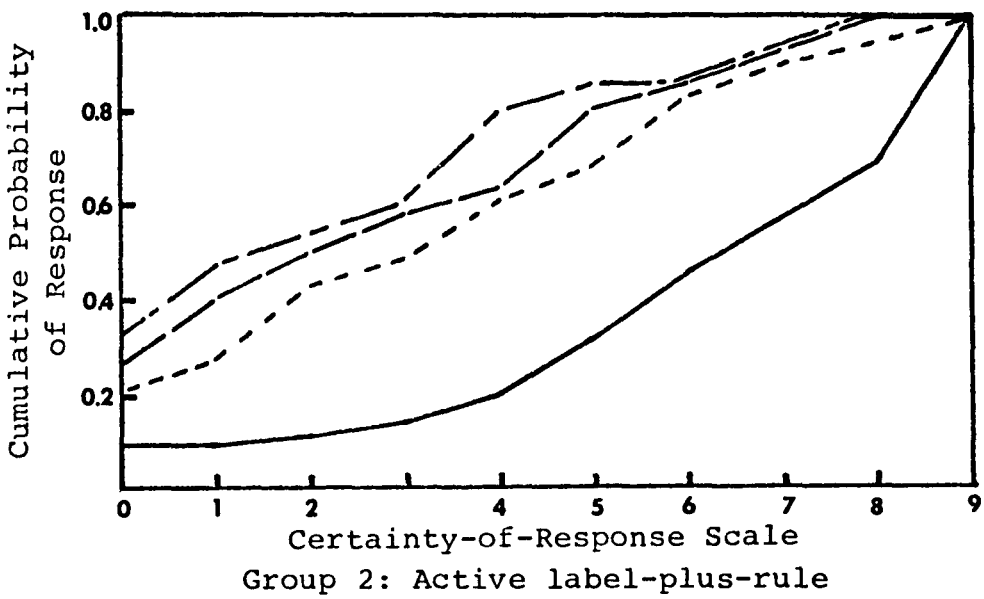


Group 6: Passive Control

Delayed Generalization

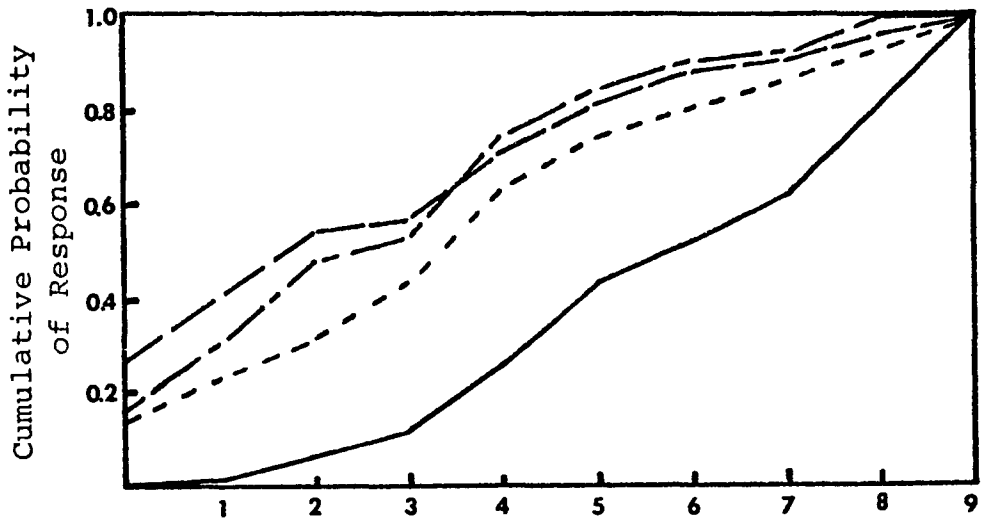


Group 1: Active label-only

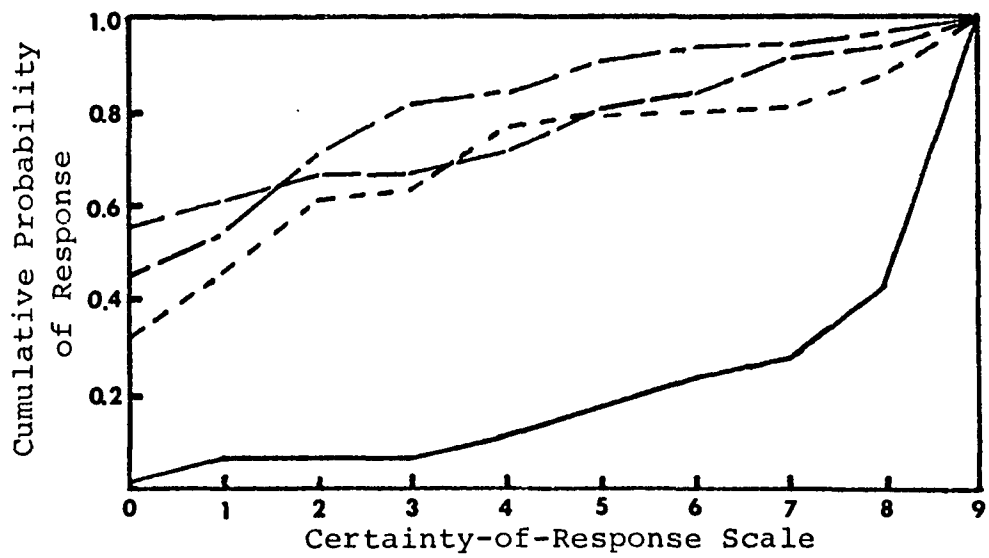


Group 2: Active label-plus-rule

Delayed Generalization--Continued

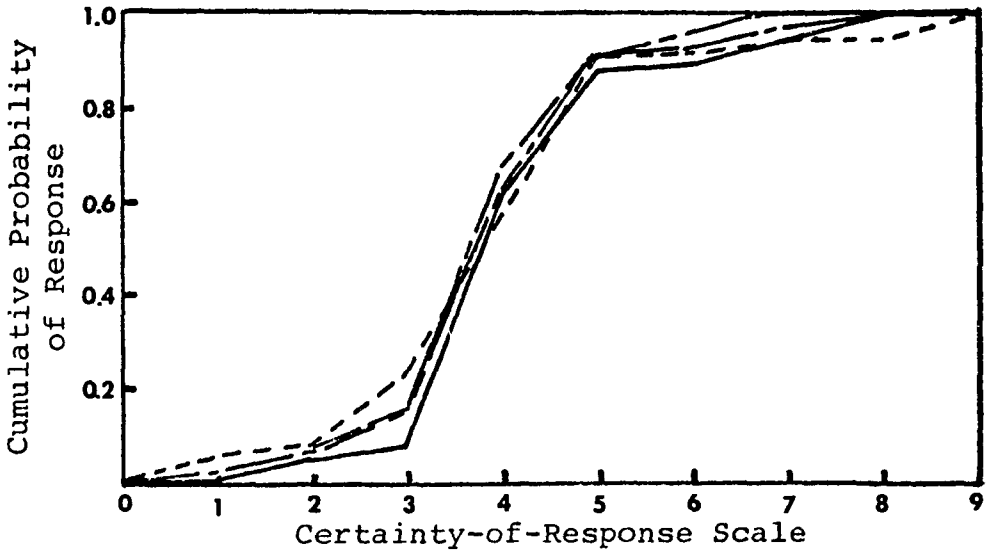


Group 4: Passive label-only

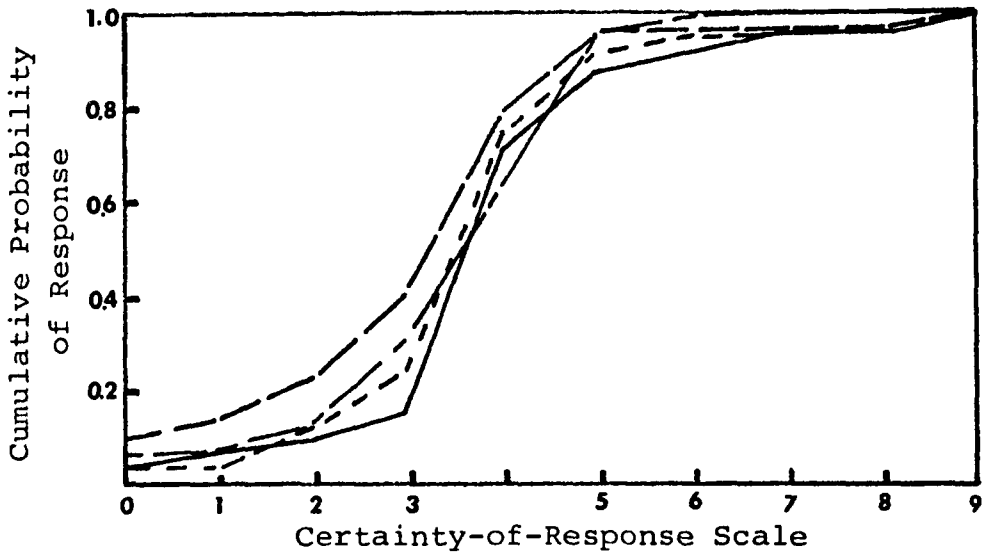


Group 5: Passive label-plus-rule

Delayed Generalization--Continued

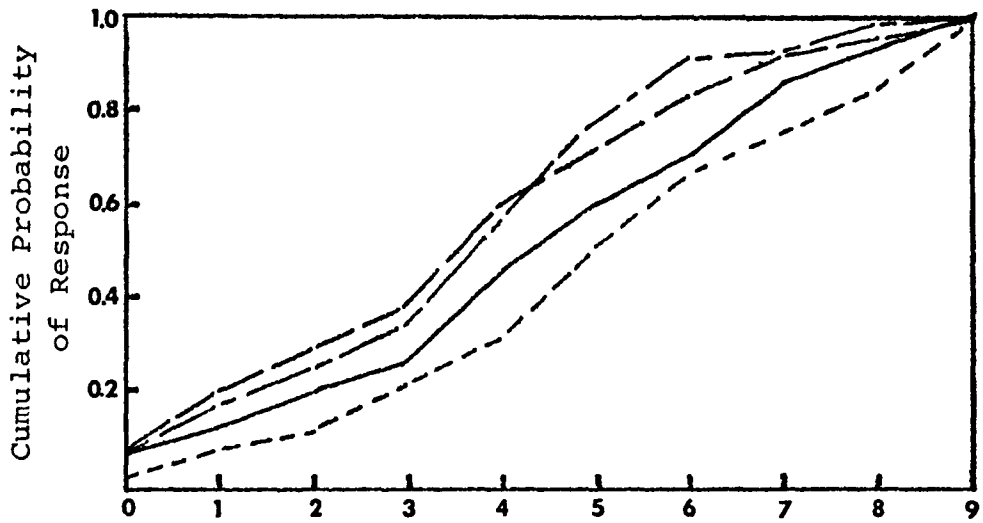


Group 3: Active Control

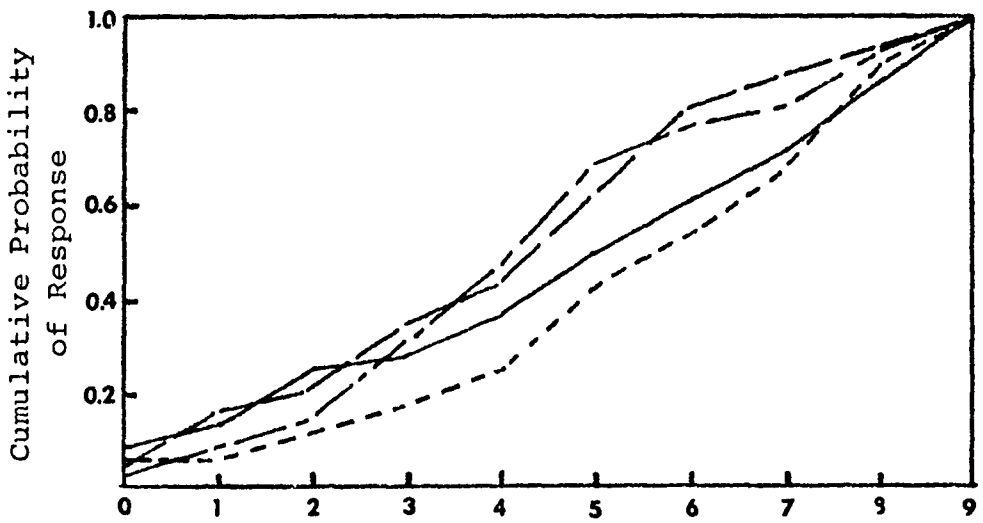


Group 6: Passive Control

Aesthetic Preference

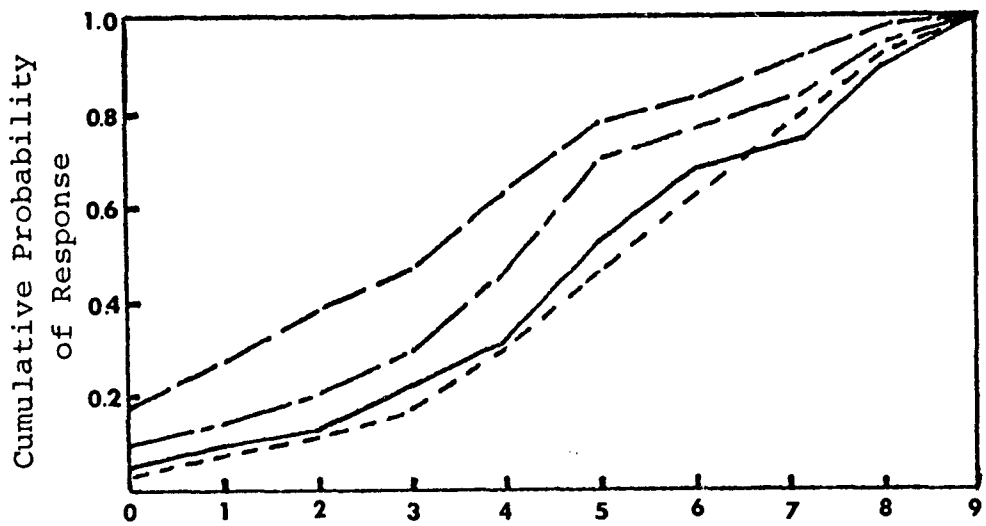


Group 1: Active label-only

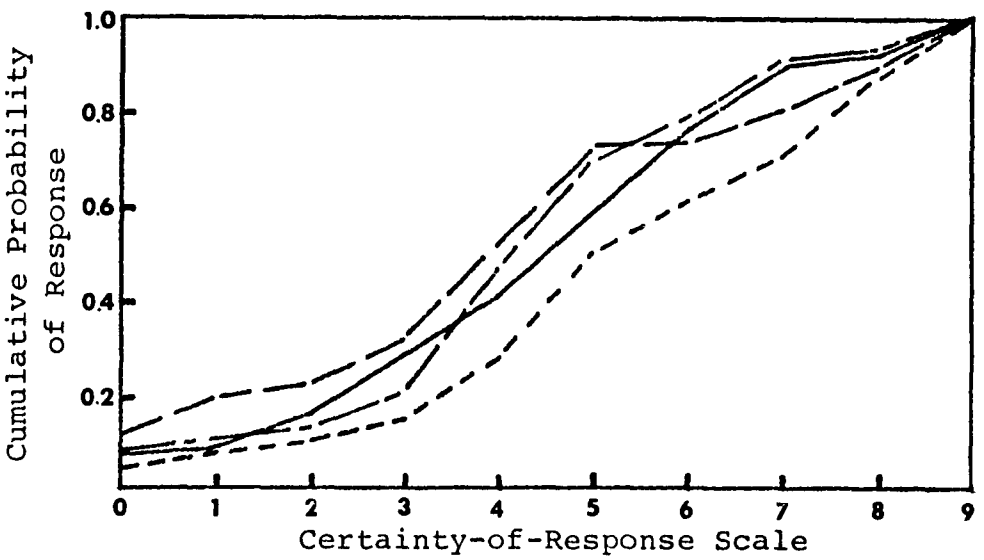


Group 2: Active label-plus-rule

Aesthetic Preference--Continued

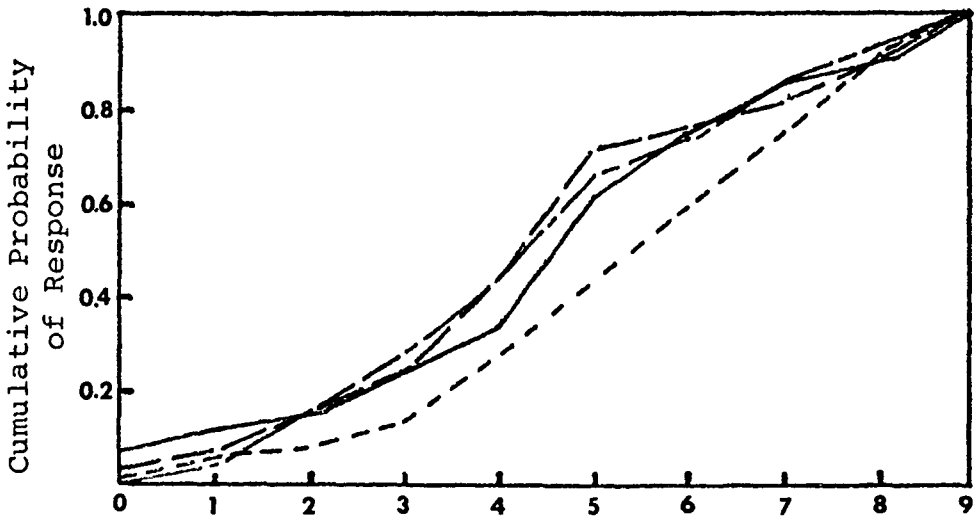


Group 4: Passive label-only

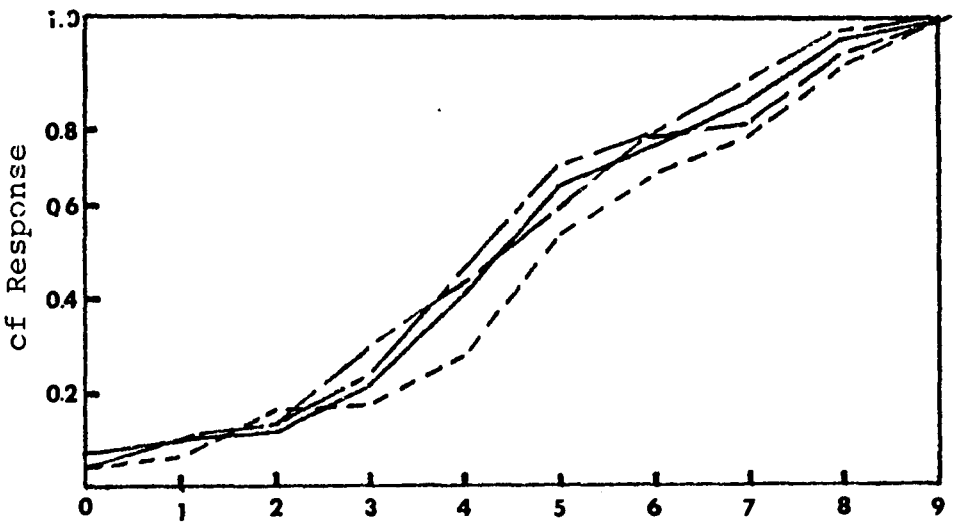


Group 5: Passive label-plus-rule

Aesthetic Preference--Continued



Group 3: Active Control



Group 6: Passive Control

APPENDIX D

LISTINGS OF TSD CUMULATIVE PROBABILITIES

Immediate Concept Generalization: TSD Average Cumulative Probabilities (Accumulated from 9 to 0) from Which ROC Functions can be Constructed; and Average z-Transformations Used to Compute d_m

Confidence Level	Artist A: Manet				Artist B: Renoir				Artist C: Degas				Artist D: Lautrec			
	f	cf	cp	z	f	cf	cp	z	f	cf	cp	z	f	cf	cp	z
Group 1 (Label):																
0	5	10.00	1.00	1.33	20	10.00	1.00	1.33	22	10.00	1.00	1.33	60	10.00	1.00	1.33
1	12	9.75	.97	1.28	27	9.00	.90	1.10	21	8.90	.89	1.07	34	7.00	.70	.55
2	8	9.15	.91	1.15	21	7.65	.65	.75	33	7.85	.78	.82	43	5.30	.53	.10
3	11	8.75	.87	1.04	21	6.60	.66	.46	21	6.20	.62	.34	22	3.15	.31	-.48
4	23	8.20	.82	.91	23	5.55	.55	.15	21	5.15	.51	.03	27	2.05	.20	-.81
5	21	7.05	.70	.60	21	4.40	.44	-.16	29	4.10	.41	-.23	5	.70	.07	-1.22
6	11	6.00	.60	.28	22	3.35	.33	-.45	17	2.65	.26	-.65	3	.45	.04	-1.27
7	27	5.45	.54	.11	20	2.25	.22	-.82	17	1.80	.18	-.89	3	.30	.03	-1.30
8	43	4.10	.41	-.24	19	1.25	.12	-1.07	13	.95	.09	-1.12	3	.15	.01	-1.33
9	39	1.95	.19	-.84	6	.30	.03	-1.30	6	.30	.03	-1.28	0	0.00	0.00	-1.33
Group 2 (Label-Plus-Rule):																
0	17	10.00	1.00	1.33	69	10.00	1.00	1.33	38	10.00	1.00	1.33	84	10.00	1.00	1.33
1	9	9.15	.91	1.15	26	6.55	.65	.46	22	8.10	.81	.85	30	5.80	.58	.23
2	16	8.70	.87	1.04	19	5.25	.52	.06	21	7.00	.70	.58	32	4.30	.43	-.21
3	11	7.90	.79	.82	12	4.30	.43	-.19	14	5.95	.59	.28	14	2.70	.27	-.65
4	13	7.35	.73	.66	10	3.70	.37	-.35	23	5.25	.52	.07	15	2.00	.20	-.86
5	13	6.70	.67	.47	17	3.20	.32	-.50	15	4.10	.41	-.24	8	1.25	.12	-1.08
6	12	6.05	.60	.29	8	2.35	.23	-.73	10	3.35	.33	-.45	1	.85	.08	-1.17
7	20	5.45	.54	.12	11	1.95	.19	-.84	21	2.85	.28	-.59	9	.80	.08	-1.18
8	35	4.45	.44	-.16	17	1.40	.14	-1.00	19	1.80	.18	-.92	5	.35	.03	-1.28
9	54	2.70	.27	-.64	11	.55	.05	-1.28	17	.85	.08	-1.18	2	.10	.01	-1.33
Group 3 (Exposure-Control):																
0	6	10.00	1.00	1.33	12	10.00	1.00	1.33	13	10.00	1.00	1.33	4	10.00	1.00	1.33
1	11	9.70	.97	1.29	8	9.40	.94	1.21	3	9.35	.93	1.22	4	9.80	.98	1.29
2	16	9.15	.91	1.15	13	9.00	.90	1.12	20	9.20	.92	1.20	14	9.60	.96	1.25
3	22	8.35	.83	.94	14	8.35	.83	.94	17	8.20	.82	.91	9	8.90	.89	1.12
4	89	7.25	.72	.62	68	7.65	.76	.74	78	7.35	.73	.67	86	8.45	.84	.98
5	48	2.80	.28	-.63	63	4.25	.42	-.20	51	3.45	.34	-.45	60	4.15	.41	-.24
6	3	.40	.04	-1.24	11	1.10	.11	-1.09	12	.90	.09	-1.10	11	1.15	.11	-1.06
7	3	.25	.02	-1.30	7	.55	.05	-1.23	4	.30	.03	-1.30	8	.60	.06	-1.21
8	1	.10	.01	-1.33	2	.20	.02	-1.32	1	.10	.01	-1.33	2	.20	.02	-1.30
9	1	.05	.00	-1.33	2	.10	.01	-1.33	1	.05	.00	-1.33	2	.10	.01	-1.33

Immediate Concept Generalization--Continued

Confidence Level	Artist A: Manet f	cf	cp	z	Artist B: Renoir f	cf	cp	z	Artist C: Degas f	cf	cp	z	Artist D: Lautrec f	cf	cp	z
Group 4 (Label):																
0	12	10.00	1.00	1.33	38	10.00	1.00	1.33	40	10.00	1.00	1.33	80	10.00	1.00	1.33
1	9	9.40	.94	1.21	22	8.10	.81	.88	17	8.00	.80	.81	25	6.00	.60	.30
2	13	8.95	.89	1.10	29	7.00	.70	.56	36	7.15	.71	.61	39	4.75	.47	-.06
3	13	8.30	.83	.94	20	5.55	.55	.14	17	5.35	.53	.10	19	2.80	.28	-.66
4	20	7.65	.76	.80	14	4.55	.45	-.12	21	4.50	.45	-.13	13	1.85	.18	-.89
5	21	6.65	.66	.48	20	3.85	.38	-.30	21	3.45	.34	-.41	11	1.20	.12	-1.07
6	21	5.60	.56	.19	17	2.85	.28	-.63	11	2.40	.24	-.73	5	.65	.06	-1.19
7	31	4.55	.45	-.11	21	2.00	.20	-.84	18	1.85	.18	-.90	3	.40	.04	-1.24
8	28	3.00	.30	-.55	11	.95	.09	-1.11	12	.95	.09	-1.15	4	.25	.02	-1.28
9	32	1.60	.16	-.96	8	.40	.04	-1.26	7	.35	.03	-1.30	1	.05	.00	-1.33
Group 5 (Label-Plus-Rule):																
0	24	10.00	1.00	1.33	95	10.00	1.00	1.33	89	10.00	1.00	1.33	140	10.00	1.00	1.33
1	8	8.80	.88	1.05	17	5.25	.52	.07	17	5.55	.55	.16	19	3.00	.30	-.59
2	16	8.40	.84	.96	20	4.40	.44	-.15	19	4.70	.47	-.07	24	2.05	.20	-.81
3	7	7.60	.76	.71	10	3.40	.34	-.44	10	3.75	.37	-.34	7	.85	.08	-1.19
4	11	7.25	.72	.63	12	2.90	.29	-.58	17	3.25	.32	-.49	2	.50	.05	-1.24
5	8	6.70	.67	.48	10	2.30	.23	-.78	7	2.40	.24	-.73	2	.40	.04	-1.27
6	9	6.30	.63	.35	5	1.80	.18	-.93	3	2.05	.20	-.83	1	.30	.03	-1.30
7	19	5.85	.58	.22	14	1.55	.15	-1.03	12	1.90	.19	-.88	0	.25	.02	-1.30
8	35	4.90	.49	-.03	10	.85	.08	-1.19	19	1.30	.13	-1.08	4	.25	.02	-1.30
9	63	3.15	.31	-.52	7	.35	.03	-1.30	7	.35	.03	-1.30	1	.05	.00	-1.33
Group 6 (Exposure-Control):																
0	20	10.00	1.00	1.33	18	10.00	1.00	1.33	16	10.00	1.00	1.33	17	10.00	1.00	1.33
1	1	9.00	.90	1.07	5	9.10	.91	1.12	6	9.20	.92	1.14	5	9.15	.91	1.11
2	14	8.95	.89	1.06	16	8.85	.88	1.04	24	8.90	.89	1.08	12	8.90	.89	1.05
3	26	8.25	.82	.89	31	8.05	.80	.86	24	7.70	.77	.77	32	8.30	.83	.92
4	70	6.95	.69	.54	46	6.50	.65	.43	60	6.50	.65	.42	69	6.70	.67	.48
5	44	3.45	.34	-.43	53	4.20	.42	-.21	48	3.50	.35	-.41	48	3.25	.32	-.49
6	15	1.25	.12	-1.03	16	1.55	.15	-.96	13	1.10	.11	-1.06	6	.85	.08	-1.17
7	4	.50	.05	-1.22	8	.75	.07	-1.17	6	.45	.04	-1.25	9	.55	.05	-1.20
8	2	.30	.03	-1.29	2	.35	.03	-1.26	1	.15	.01	-1.31	0	.10	.01	-1.31
9	4	.20	.02	-1.30	5	.25	.02	-1.28	2	.10	.01	-1.31	2	.10	.01	-1.31

f = frequency; cf = cumulative frequency; cp = cumulative probability; z = standard z-score transformations.

Concept Retention and Delayed Generalization: TSD Average Cumulative Probabilities (Accumulated from 9 to 0) from Which ROC Functions can be Constructed; and Average z-Transformations Used to Compute d_m

Confidence Level	Artist A: Manet f	cf	cp	z	Artist B: Renoir f	cf	cp	z	Artist C: Degas f	cf	cp	z	Artist D: Lautrec f	cf	cp	z
Group 1 (n = 17) (Label):																
0	7	6.00	1.00	1.07	20	6.00	1.00	1.07	20	6.00	1.00	1.07	36	6.00	1.00	1.07
1	1	5.59	.93	.97	9	4.82	.80	.72	12	4.82	.80	.74	7	3.88	.65	.33
2	7	5.53	.92	.97	5	4.29	.72	.51	9	4.12	.69	.49	14	3.47	.58	.16
3	5	5.12	.85	.82	12	4.00	.67	.42	12	3.59	.60	.25	14	2.65	.44	-.17
4	9	4.82	.80	.70	13	3.29	.55	.15	16	2.88	.48	-.06	9	1.82	.30	-.53
5	11	4.29	.72	.51	12	2.53	.42	-.20	15	1.94	.32	-.47	5	1.29	.22	-.75
6	12	3.65	.61	.29	12	1.82	.30	-.52	6	1.06	.18	-.86	6	1.00	.17	-.80
7	12	2.94	.49	.01	12	1.12	.19	-.80	4	.71	.12	-.92	5	.65	.11	-.93
8	19	2.24	.37	-.31	5	.41	.07	-1.00	6	.47	.08	-.97	1	.35	.06	-.96
9	19	1.12	.19	-.73	2	.12	.02	-1.05	2	.12	.02	-1.05	5	.29	.05	-.98
Group 2 (n = 14) (Label-Plus-Rule):																
0	8	6.00	1.00	1.07	24	6.00	1.00	1.07	28	6.00	1.00	1.07	32	6.00	1.00	1.07
1	2	5.43	.90	.95	4	4.29	.71	.53	10	4.00	.67	.40	8	3.71	.62	.27
2	3	5.29	.88	.93	8	4.00	.67	.42	8	3.29	.55	.13	8	3.14	.52	.04
3	2	5.07	.85	.88	4	3.43	.57	.19	4	2.71	.45	-.11	8	2.57	.43	-.17
4	5	4.93	.82	.74	10	3.14	.52	.05	15	2.43	.40	-.22	5	2.00	.33	-.42
5	11	4.57	.76	.71	7	2.43	.40	-.27	5	1.36	.23	-.66	9	1.64	.27	-.58
6	6	3.79	.63	.34	8	1.93	.32	-.44	1	1.00	.17	-.79	2	1.00	.17	-.84
7	14	3.35	.56	.15	11	1.36	.23	-.70	7	.93	.15	-.80	4	.86	.14	-.89
8	8	2.36	.39	-.26	4	.47	.10	-.95	5	.43	.07	-.99	8	.57	.10	-.98
9	25	1.79	.30	-.45	4	.29	.05	-1.01	1	.07	.01	-1.06	0	0.00	0.00	-1.07
Group 3 (n = 18) (Exposure-Control):																
0	0	6.00	1.00	1.07	5	6.00	1.00	1.07	2	6.00	1.00	1.07	3	6.00	1.00	1.07
1	1	6.00	1.00	1.07	2	5.72	.95	1.04	4	5.89	.98	1.05	3	5.83	.97	1.05
2	3	5.94	.99	1.06	5	5.61	.94	1.00	3	5.67	.94	.99	8	5.67	.94	.97
3	10	5.78	.96	.99	11	5.33	.89	.93	10	5.50	.92	.93	7	5.22	.87	.79
4	48	5.22	.87	.80	38	4.72	.79	.71	44	4.94	.82	.77	50	4.83	.81	.65
5	32	2.56	.43	-.20	37	2.61	.44	-.16	33	2.50	.42	-.21	29	2.06	.34	-.43
6	3	.78	.13	-.79	4	.56	.09	-.92	8	.67	.11	-.87	5	.44	.07	-.94
7	6	.61	.10	-.86	3	.33	.06	-.97	3	.22	.04	-1.02	2	.17	.03	-1.01
8	5	.28	.05	-.99	0	.17	.03	-1.02	1	.06	.01	-1.06	1	.06	.01	-1.06
9	0	0.00	0.00	-1.07	3	.17	.03	-1.02	0	0.00	0.00	-1.07	0	0.00	0.00	-1.07

Concept Retention and Delayed Generalization--Continued

Confidence Level	Artist A: Manet f	cf	cp	z	Artist B: Renoir f	cf	cp	z	Artist C: Degas f	cf	cp	z	Artist D: Lautrec f	cf	cp	z
Group 4 (n = 20) (Label):																
0	4	6.00	1.00	1.07	20	6.00	1.00	1.07	25	6.00	1.00	1.07	40	6.00	1.00	1.07
1	1	5.80	.97	1.02	8	5.00	.83	.80	14	4.75	.79	.68	19	4.00	.67	.37
2	5	5.75	.96	1.02	10	4.60	.77	.66	21	4.05	.67	.45	16	3.05	.51	-.01
3	7	5.50	.92	.93	10	4.10	.68	.45	8	3.00	.50	.01	6	2.25	.37	-.32
4	13	5.15	.86	.83	19	3.60	.60	.25	25	2.60	.43	-.18	16	1.95	.32	-.43
5	23	4.50	.75	.61	15	2.65	.44	-.15	11	1.35	.22	-.72	8	1.15	.19	-.73
6	9	3.35	.56	.14	5	1.90	.32	-.41	5	.80	.13	-.83	5	.75	.12	-.85
7	14	2.90	.48	-.05	13	1.65	.27	-.53	3	.55	.09	-.92	3	.50	.08	-.92
8	17	2.20	.37	-.31	9	1.00	.17	-.77	5	.40	.07	-.98	2	.35	.06	-.98
9	27	1.35	.22	-.59	11	.55	.09	-.91	3	.15	.02	-1.05	5	.25	.04	-.99
Group 5 (n = 15) (Label-Plus-Rule):																
0	3	6.00	1.00	1.07	36	6.00	1.00	1.07	44	6.00	1.00	1.07	57	6.00	1.00	1.07
1	3	5.80	.97	1.02	9	3.60	.60	.21	8	3.07	.51	.04	4	2.20	.37	-.36
2	3	5.60	.93	.97	10	3.00	.50	.01	10	2.53	.42	-.21	6	1.93	.32	-.46
3	1	5.40	.90	.92	1	2.33	.39	-.29	8	1.87	.31	-.51	0	1.53	.26	-.65
4	4	5.33	.89	.91	8	2.27	.38	-.29	3	1.33	.22	-.73	6	1.53	.26	-.65
5	5	5.07	.84	.86	3	1.73	.29	-.52	7	1.13	.19	-.82	3	1.13	.19	-.77
6	6	4.73	.79	.73	1	1.53	.26	-.62	3	.67	.11	-.94	5	.93	.16	-.84
7	5	4.33	.72	.55	4	1.47	.24	-.65	1	.47	.08	-.96	4	.60	.10	-.95
8	14	4.00	.67	.44	8	1.20	.20	-.76	4	.40	.07	-1.00	1	.33	.06	-1.00
9	46	3.07	.51	.02	10	.67	.11	-.90	2	.13	.02	-1.05	4	.27	.04	-1.01
Group 6 (n = 13) (Exposure-Control):																
0	6	6.00	1.00	1.07	11	6.00	1.00	1.07	7	6.00	1.00	1.07	6	6.00	1.00	1.07
1	0	5.54	.92	.90	0	5.15	.86	.80	2	5.46	.91	.89	4	5.54	.92	.92
2	2	5.54	.92	.90	4	5.15	.86	.80	4	5.31	.88	.82	3	5.23	.87	.79
3	10	5.38	.90	.85	5	4.85	.81	.69	10	5.00	.83	.73	10	5.00	.83	.73
4	34	4.62	.77	.60	31	4.46	.74	.59	28	4.23	.71	.48	32	4.23	.71	.42
5	16	2.00	.33	-.43	21	2.08	.35	-.40	26	2.08	.35	-.43	22	1.77	.29	-.55
6	5	.77	.13	-.84	5	.46	.08	-.99	1	.08	.01	-1.06	0	.08	.01	-1.06
7	1	.38	.06	-.99	0	.08	.01	-1.06	0	0.00	0.00	-1.07	0	.08	.01	-1.06
8	1	.31	.05	-1.00	0	.08	.01	-1.06	0	0.00	0.00	-1.07	0	.08	.01	-1.06
9	3	.23	.04	-1.01	1	.08	.01	-1.06	0	0.00	0.00	-1.07	1	.08	.01	-1.06

f = frequency; cf = cumulative frequency; cp = cumulative probability; z = standard z-score transformations.

Concept Retention: TSD Average Cumulative Probabilities (Accumulated from 9 to 0) from Which ROC Functions can be Constructed; and Average z-Transformations Used to Compute d_m

Confidence Level	Artist A: Manet f	cf	cp	z	Artist B: Renoir f	cf	cp	z	Artist C: Degas f	cf	cp	z	Artist D: Lautrec f	cf	cp	z
Group 1 (n = 17) (Label):																
0	5	17.00	1.00	1.61	11	11.00	1.00	1.61	10	17.00	1.00	1.61	22	17.00	1.00	1.61
1	0	15.33	.90	1.14	2	13.33	.78	.80	4	13.66	.80	.78	3	9.66	.56	.15
2	3	15.33	.90	1.14	2	12.66	.74	.71	5	12.33	.72	.59	7	8.66	.50	.02
3	2	14.33	.84	.98	6	12.00	.70	.62	8	10.66	.62	.29	8	6.33	.37	-.29
4	5	13.66	.80	.79	5	10.00	.58	.27	5	8.00	.47	-.06	3	3.66	.21	-.68
5	4	12.00	.70	.48	6	8.33	.49	-.00	9	6.33	.37	-.29	2	2.66	.15	-.86
6	5	10.66	.62	.31	8	6.33	.37	-.31	4	3.33	.19	-.75	2	2.00	.11	-1.01
7	7	9.00	.52	.07	5	3.66	.21	-.71	1	2.00	.11	-1.01	0	1.33	.07	-1.20
8	10	6.66	.39	-.25	4	2.00	.11	-1.07	4	1.66	.09	-1.08	0	1.33	.07	-1.20
9	10	3.33	.19	-.85	2	1.66	.03	-1.41	1	.33	.01	-1.49	4	1.33	.07	-1.20
Group 2 (n = 14) (Label-Plus-Rule):																
0	4	14.00	1.00	1.53	15	14.00	1.00	1.53	14	14.00	1.00	1.53	21	14.00	1.00	1.53
1	2	12.66	.90	1.18	1	9.00	.64	.38	4	9.33	.66	.40	2	7.00	.50	-.00
2	2	12.00	.85	1.07	2	8.66	.61	.32	5	8.00	.57	.18	4	6.33	.45	-.10
3	1	11.33	.80	.89	2	8.00	.57	.17	1	6.33	.45	-.10	4	5.00	.35	-.32
4	2	11.00	.78	.84	4	7.33	.52	.05	7	6.00	.42	-.16	3	3.66	.26	-.56
5	6	10.33	.73	.66	4	6.00	.42	-.21	3	3.66	.26	-.56	2	2.66	.19	-.74
6	1	8.33	.59	.23	2	4.66	.33	-.43	1	2.66	.19	-.75	0	2.00	.14	-.90
7	9	8.00	.57	.17	8	4.00	.28	-.54	4	2.33	.16	-.83	1	2.00	.14	-.90
8	3	5.00	.35	-.45	2	1.33	.09	-1.11	2	1.00	.07	-1.18	5	1.66	.11	-.98
9	12	4.00	.28	-.61	2	.66	.04	-1.31	1	.33	.02	-1.40	0	0.00	0.00	-1.53
Group 3 (n = 18) (Exposure-Control):																
0	0	18.00	1.00	1.64	4	18.00	1.00	1.64	1	18.00	1.00	1.64	2	18.00	1.00	1.64
1	0	18.00	1.00	1.64	0	16.66	.92	1.32	3	17.66	.98	1.52	2	17.33	.96	1.44
2	1	18.00	1.00	1.64	3	16.66	.92	1.32	2	16.66	.92	1.23	4	16.66	.92	1.19
3	9	17.66	.98	1.53	3	15.66	.87	1.02	4	16.00	.88	1.03	4	15.33	.85	.91
4	18	14.66	.81	.79	19	14.66	.81	.81	20	14.66	.81	.79	23	14.00	.77	.67
5	19	8.66	.48	-.04	20	8.33	.46	-.08	18	8.00	.44	-.13	16	6.33	.35	-.33
6	2	2.33	.12	-.96	3	1.66	.09	-1.11	5	2.00	.11	-1.07	2	1.00	.05	-1.28
7	3	1.66	.09	-1.11	2	.66	.03	-1.40	1	.33	.01	-1.52	0	.33	.01	-1.52
8	2	.66	.03	-1.44	0	0.00	0.00	-1.64	0	0.00	0.00	-1.64	1	.33	.01	-1.52
9	0	0.00	0.00	-1.64	0	0.00	0.00	-1.64	0	0.00	0.00	-1.64	0	0.00	0.00	-1.64

Concept Retention--Continued

Confidence Level	Artist A: Manet f	cf	cp	z	Artist B: Renoir f	cf	cp	z	Artist C: Degas f	cf	cp	z	Artist D: Lautrec f	cf	cp	z
Group 4 (n = 20) (Label):																
0	3	20.00	1.00	1.69	11	20.00	1.00	1.69	15	20.00	1.00	1.69	23	20.00	1.00	
1	1	19.00	.95	1.37	3	16.33	.81	.88	5	15.00	.75	.63	11	12.33	.61	
2	2	18.66	.93	1.31	5	15.33	.76	.77	11	13.33	.66	.41	8	8.66	.43	
3	3	18.00	.90	1.11	3	13.66	.68	.48	5	9.66	.48	-.03	5	6.00	.30	
4	6	17.00	.85	.94	7	12.66	.63	.36	12	8.00	.40	-.22	7	4.33	.21	
5	12	15.00	.75	.67	8	10.33	.51	.04	5	4.00	.20	-.76	2	2.00	.10	
6	4	11.00	.55	.11	2	7.66	.38	-.27	2	2.33	.11	-1.11	1	1.33	.06	
7	8	9.66	.48	-.03	10	7.00	.35	-.36	1	1.66	.08	-1.23	1	1.00	.05	
8	6	7.00	.35	-.34	5	3.66	.18	-.86	1	1.33	.06	-1.31	0	.66	.03	
9	15	5.00	.25	-.61	6	2.00	.10	-1.17	3	1.00	.05	-1.42	2	.66	.03	
Group 5 (n = 15) (Label-Plus-Rule):																
0	2	15.00	1.00	1.56	21	15.00	1.00	1.56	23	15.00	1.00	1.56	31	15.00	1.00	1.56
1	1	14.33	.95	1.31	3	8.00	.53	.07	4	7.33	.48	-.03	2	4.66	.31	-.42
2	3	14.00	.93	1.22	3	7.00	.46	-.13	3	6.00	.40	-.25	4	4.00	.26	-.53
3	1	13.00	.86	1.00	0	6.00	.40	-.28	3	5.00	.33	-.40	0	2.66	.17	-.78
4	2	12.66	.84	.94	2	6.00	.40	-.28	2	4.00	.26	-.57	3	2.66	.17	-.78
5	2	12.00	.80	.82	2	5.33	.35	-.39	4	3.33	.22	-.70	0	1.66	.11	-1.01
6	3	11.33	.75	.64	1	4.66	.31	-.49	1	2.00	.13	-.94	3	1.66	.11	-1.01
7	3	10.33	.68	.49	3	4.33	.28	-.61	1	1.66	.11	-1.01	0	.66	.04	-1.31
8	8	9.33	.62	.28	5	3.33	.22	-.77	3	1.33	.08	-1.13	0	.66	.04	-1.31
9	20	6.66	.44	-.12	5	1.66	.11	-1.09	1	.33	.02	-1.43	2	.66	.04	-1.31
Group 6 (n = 13) (Exposure-Control):																
0	3	13.00	1.00	1.50	9	13.00	1.00	1.50	5	13.00	1.00	1.50	1	13.00	1.00	1.50
1	0	12.00	.92	1.10	0	10.00	.76	.65	1	11.33	.87	.94	2	12.66	.97	1.36
2	0	12.00	.92	1.10	1	10.00	.76	.65	2	11.00	.84	.85	1	12.00	.92	1.14
3	7	12.00	.92	1.10	0	9.66	.74	.59	3	10.33	.79	.71	3	11.66	.89	1.05
4	14	9.66	.74	.55	12	9.66	.74	.59	13	9.33	.71	.49	16	10.66	.82	.76
5	10	5.00	.38	-.25	13	5.66	.43	-.13	15	5.00	.38	-.26	15	5.33	.41	-.19
6	2	1.66	.12	-.94	4	1.33	.10	-1.05	0	0.00	0.00	-1.50	0	.33	.02	-1.36
7	0	1.00	.07	-1.14	0	0.00	0.00	-1.50	0	0.00	0.00	-1.50	0	.33	.02	-1.36
8	1	1.00	.07	-1.14	0	0.00	0.00	-1.50	0	0.00	0.00	-1.50	0	.33	.02	-1.36
9	2	.66	.05	-1.23	0	0.00	0.00	-1.50	0	0.00	0.00	-1.50	1	.33	.02	-1.36

f = frequency; cf = cumulative frequency; cp = cumulative probability; z = standard z-score transformations.

Delayed Generalization: TSD Average Cumulative Probabilities (Accumulated from 9 to 0) from Which ROC Functions can be Constructed; and Average z-Transformations Used to Compute d_m

Confidence Level	Artist A: Manet				Artist B: Renoir				Artist C: Degas				Artist D: Lautrec			
	f	cf	cp	z	f	cf	cp	z	f	cf	cp	z	f	cf	cp	z
Group 1 (n = 17) (Label):																
0	2	17.00	1.00	1.61	9	17.00	1.00	1.61	9	17.00	1.00	1.61	14	17.00	1.00	1.61
1	1	16.33	.96	1.41	7	14.00	.82	.82	8	14.00	.82	.97	4	12.33	.72	.55
2	4	16.00	.94	1.34	3	11.66	.68	.47	4	11.33	.66	.53	7	11.00	.64	.37
3	3	14.66	.86	1.06	6	10.66	.62	.31	4	10.00	.58	.21	6	8.66	.50	.03
4	3	13.66	.80	.81	8	8.66	.50	-.04	12	8.66	.50	-.09	6	6.66	.39	-.28
5	7	12.66	.74	.62	6	6.00	.35	-.41	6	4.66	.27	-.62	3	4.66	.27	-.63
6	7	10.33	.60	.26	4	4.00	.23	-.72	2	2.66	.15	-.96	4	3.66	.21	-.77
7	5	8.00	.47	-.08	7	2.66	.15	-.94	3	2.00	.11	-1.07	5	2.33	.13	-.99
8	10	6.33	.37	-.45	1	.33	.01	-1.49	2	1.00	.05	-1.29	1	.66	.03	-1.37
9	9	3.00	.17	-.91	0	0.00	0.00	-1.61	1	.33	.01	-1.49	1	.33	.01	-1.49
Group 2 (n = 14) (Label-Plus-Rule):																
0	4	14.00	1.00	1.53	9	14.00	1.00	1.53	14	14.00	1.00	1.53	11	14.00	1.00	1.53
1	0	12.66	.90	1.10	3	11.00	.78	.71	6	9.33	.66	.40	6	10.33	.73	.59
2	1	12.66	.90	1.10	6	10.00	.71	.51	3	7.33	.52	.00	4	8.33	.59	.24
3	1	12.33	.88	1.02	2	8.00	.57	.16	3	6.33	.45	-.24	4	7.00	.50	-.00
4	3	12.00	.85	.96	6	7.33	.52	.04	8	5.33	.38	-.40	2	5.66	.40	-.25
5	5	11.00	.78	.71	3	5.33	.38	-.33	2	2.66	.19	-.83	7	5.00	.35	-.35
6	5	9.33	.66	.37	6	4.33	.30	-.49	0	2.00	.14	-.96	2	2.66	.19	-.78
7	5	7.66	.54	.10	3	2.33	.16	-.91	3	2.00	.14	-.96	3	2.00	.14	-.92
8	5	6.00	.42	-.16	2	1.33	.09	-1.10	3	1.00	.07	-1.18	3	1.00	.07	-1.14
9	13	4.33	.30	-.45	2	.66	.04	-1.27	0	0.00	0.00	-1.53	0	0.00	0.00	-1.53
Group 3 (n = 18) (Exposure-Control):																
0	0	18.00	1.00	1.64	1	18.00	1.00	1.64	1	18.00	1.00	1.64	1	18.00	1.00	1.64
1	1	18.00	1.00	1.64	2	17.66	.98	1.52	1	17.66	.98	1.52	1	17.66	.98	1.52
2	2	17.66	.98	1.52	2	17.00	.94	1.31	1	17.33	.96	1.40	4	17.33	.96	1.40
3	1	17.00	.94	1.31	8	16.33	.90	1.13	6	17.00	.94	1.31	3	16.00	.88	1.11
4	30	16.66	.92	1.23	19	13.66	.75	.62	24	15.00	.83	.84	28	15.00	.83	.84
5	13	6.66	.27	-.30	17	7.33	.40	-.21	15	7.00	.38	-.25	12	5.66	.31	-.43
6	1	2.33	.12	-.96	1	1.66	.09	-1.11	3	2.00	.11	-1.03	3	1.66	.09	-1.11
7	3	2.00	.11	-1.03	1	1.33	.07	-1.23	2	1.00	.05	-1.31	2	.66	.03	-1.40
8	3	1.00	.05	-1.31	0	1.00	.05	-1.31	1	.33	.01	-1.52	0	0.00	0.00	-1.64
9	0	0.00	0.00	-1.64	3	1.00	.05	-1.31	0	0.00	0.00	-1.64	0	0.00	0.00	-1.64

Delayed Generalization--Continued

Confidence Level	Artist A: Manet f	cf	cp	z	Artist B: Renoir f	cf	cp	z	Artist C: Degas f	cf	cp	z	Artist D: Lautrec f	cf	cp	z
Group 4 (n = 20) (Label):																
0	1	20.00	1.00	1.69	9	20.00	1.00	1.69	10	20.00	1.00	1.69	17	20.00	1.00	1.69
1	0	19.66	.98	1.57	5	17.00	.85	1.04	9	16.66	.83	.96	8	14.33	.71	.54
2	3	19.66	.98	1.57	5	15.33	.76	.82	10	13.66	.68	.46	8	11.66	.58	.19
3	4	18.66	.93	1.31	7	13.66	.68	.51	3	10.33	.51	.03	1	9.00	.45	-.11
4	7	17.33	.86	.97	12	11.33	.56	.14	13	9.33	.46	-.10	9	8.66	.43	-.15
5	11	15.00	.75	.66	7	7.33	.36	-.48	6	5.00	.25	-.67	6	5.66	.28	-.55
6	5	11.33	.56	.15	3	5.00	.25	-.75	3	3.00	.15	-1.01	4	3.66	.18	-.88
7	6	9.66	.48	-.04	3	4.00	.20	-.87	2	2.00	.10	-1.17	2	2.33	.11	-1.05
8	11	7.66	.38	-.28	4	3.00	.15	-1.01	4	1.33	.06	-1.31	2	1.66	.08	-1.19
9	12	4.00	.20	-.77	5	1.66	.08	-1.23	0	0.00	0.00	-1.69	3	1.00	.05	-1.37
Group 5 (n = 15) (Label-Plus-Rule):																
0	1	15.00	1.00	1.56	15	15.00	1.00	1.56	21	15.00	1.00	1.56	26	15.00	1.00	1.56
1	2	14.66	.97	1.43	6	10.00	.66	.52	4	8.00	.53	.10	2	6.33	.42	-.18
2	0	14.00	.93	1.28	7	8.00	.53	.07	7	6.66	.44	-.12	2	5.66	.37	-.30
3	0	14.00	.93	1.28	1	5.66	.37	-.30	5	4.33	.28	-.63	0	5.00	.33	-.42
4	2	14.00	.93	1.28	6	5.33	.35	-.35	1	2.66	.17	-.90	3	5.00	.33	-.42
5	3	13.33	.88	1.16	1	3.33	.22	-.78	3	2.33	.15	-.95	3	4.00	.26	-.63
6	3	12.33	.82	.90	0	3.00	.20	-.85	2	1.33	.08	-1.22	2	3.00	.20	-.85
7	2	11.33	.75	.65	1	3.00	.20	-.85	0	.66	.04	-1.35	4	2.33	.15	-.99
8	6	10.66	.71	.56	3	2.66	.17	-.90	1	.66	.04	-1.35	1	1.00	.06	-1.28
9	26	8.66	.57	.19	5	1.66	.11	-1.09	1	.33	.02	-1.43	2	.66	.04	-1.35
Group 6 (n = 13) (Exposure-Control):																
0	3	13.00	1.00	1.50	2	13.00	1.00	1.50	2	13.00	1.00	1.50	4	13.00	1.00	1.50
1	0	12.00	.92	1.10	0	12.33	.94	1.23	1	12.33	.94	1.23	2	11.66	.89	1.01
2	1	12.00	.92	1.10	3	12.33	.94	1.23	2	12.00	.92	1.10	3	11.00	.84	.83
3	3	11.00	.89	1.01	5	11.33	.87	.94	7	11.33	.87	.94	7	10.00	.76	.62
4	21	10.00	.82	.79	19	9.66	.74	.55	15	9.00	.69	.45	15	7.66	.58	.19
5	6	3.66	.28	-.50	8	3.33	.25	-.55	11	4.00	.30	-.43	7	2.66	.20	-.73
6	3	1.66	.12	-.92	1	.66	.05	-1.23	1	.33	.02	-1.36	0	.33	.02	-1.36
7	1	.66	.05	-1.23	0	.33	.02	-1.36	0	0.00	0.00	-1.50	0	.33	.02	-1.36
8	0	.33	.02	-1.36	0	.33	.02	-1.36	0	0.00	0.00	-1.50	0	.33	.02	-1.36
9	1	.33	.02	-1.36	1	.33	.02	-1.36	0	0.00	0.00	-1.50	1	.33	.02	-1.36

f = frequency; cf = cumulative frequency; cp = cumulative probability; z = standard z-score transformations.

Aesthetic Preference: TSD Average Cumulative Probabilities (Accumulated from 9 to 0) from Which ROC Functions can be Constructed; and Average z-Transformations Used to Compute d_m

Confidence Level	Artist A: Manet				Artist B: Renoir				Artist C: Degas				Artist D: Lautrec			
	f	cf	cp	z	f	cf	cp	z	f	cf	cp	z	f	cf	cp	z
Group 1 (n = 17) (Label):																
0	7	6.00	1.00	1.07	4	6.00	1.00	1.07	7	6.00	1.00	1.07	7	6.00	1.00	1.07
1	7	5.59	.93	.97	3	5.76	.96	1.02	11	5.59	.93	.97	13	5.59	.93	.98
2	7	5.18	.86	.84	6	5.59	.93	1.00	7	4.94	.82	.74	10	4.82	.80	.77
3	6	4.76	.79	.71	9	5.24	.87	.87	11	4.53	.75	.58	8	4.24	.71	.50
4	19	4.41	.74	.61	11	4.71	.78	.69	22	3.88	.65	.36	23	3.76	.63	.30
5	15	3.29	.55	-.16	19	4.06	.68	.45	22	2.59	.43	-.16	13	2.41	.40	-.22
6	10	2.41	.40	-.24	16	2.94	.49	-.04	13	1.29	.22	-.71	12	1.65	.27	-.52
7	16	1.82	.30	-.48	10	2.00	.33	-.38	3	.53	.09	-.97	8	.94	.16	-.77
8	8	.88	.15	-.81	9	1.41	.24	-.65	5	.35	.06	-1.00	3	.47	.08	-.94
9	7	.41	.07	-.95	15	.88	.15	-.80	1	.06	.01	-1.06	5	.29	.05	-1.00
Group 2 (n = 14) (Label-Plus-Rule):																
0	7	6.00	1.00	1.07	5	6.00	1.00	1.07	3	6.00	1.00	1.07	5	6.00	1.00	1.07
1	4	5.50	.92	.98	0	5.64	.94	.98	5	5.79	.96	1.04	7	5.64	.94	.97
2	10	5.21	.87	.92	5	5.64	.94	.98	5	5.43	.90	.95	5	5.14	.86	.85
3	2	4.50	.75	.65	4	5.29	.88	.88	12	5.07	.85	.86	10	4.79	.80	.74
4	9	4.36	.73	.58	7	5.00	.83	.76	15	4.21	.70	.55	10	4.07	.68	.46
5	10	3.71	.62	.32	16	4.50	.75	.56	18	3.14	.52	.05	15	3.36	.56	.16
6	9	3.00	.50	-.01	8	3.36	.56	.13	7	1.86	.31	-.49	15	2.29	.38	-.33
7	9	2.36	.39	-.28	12	2.79	.46	-.12	3	1.36	.23	-.68	5	1.21	.20	-.72
8	11	1.71	.29	-.56	16	1.93	.32	-.47	10	1.14	.19	-.72	7	.86	.14	-.87
9	13	.93	.15	-.79	11	.79	.13	-.86	6	.43	.07	-.96	5	.36	.06	-.98
Group 3 (n = 18) (Exposure-Control):																
0	8	6.00	1.00	1.07	2	6.00	1.00	1.07	1	6.00	1.00	1.07	3	6.00	1.00	1.07
1	4	5.56	.93	.97	4	5.89	.98	1.05	4	5.94	.99	1.06	3	5.83	.97	1.02
2	5	5.33	.89	.93	3	5.66	.94	1.03	12	5.72	.95	1.04	11	5.67	.94	1.01
3	9	5.06	.84	.83	5	5.50	.92	.97	11	5.06	.84	.83	9	5.06	.84	.79
4	10	4.56	.76	.71	15	5.22	.87	.89	19	4.44	.74	.59	21	4.56	.76	.62
5	31	4.00	.67	.47	18	4.39	.73	.60	24	3.39	.56	.15	30	3.39	.56	.10
6	15	2.28	.38	-.25	18	3.39	.56	.15	10	2.06	.34	-.39	5	1.72	.29	-.53
7	11	1.44	.24	-.57	16	2.39	.40	-.24	12	1.50	.25	-.62	7	1.44	.24	-.62
8	4	.83	.14	-.81	14	1.50	.25	-.61	6	.83	.14	-.85	6	1.06	.18	-.77
9	11	.61	.10	-.90	13	.72	.12	-.88	9	.50	.08	-.95	13	.72	.12	-.87

Aesthetic Preference--Continued

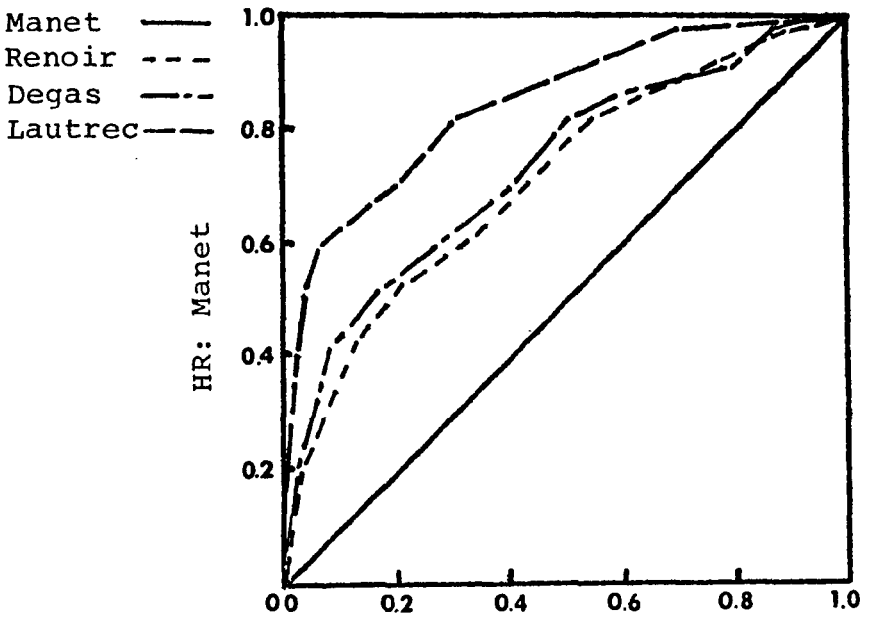
Confidence Level	Artist A: Manet f	cf	cp	z	Artist B: Renoir f	cf	cp	z	Artist C: Degas f	cf	cp	z	Artist D: Lautrec f	cf	cp	z
Group 4 (n = 20) (Label):																
0	7	6.00	1.00	1.07	6	6.00	1.00	1.07	12	6.00	1.00	1.07	23	6.00	1.00	1.07
1	7	5.65	.94	1.01	7	5.70	.95	.99	6	5.40	.90	.91	9	4.85	.81	.72
2	4	5.30	.88	.94	4	5.35	.89	.92	7	5.10	.85	.78	15	4.40	.73	.57
3	8	5.10	.85	.87	5	5.15	.86	.88	11	4.75	.79	.68	11	3.65	.61	.28
4	15	4.70	.78	.73	16	4.90	.82	.79	20	4.20	.70	.49	18	3.10	.52	.03
5	25	3.95	.66	.45	20	4.10	.68	.48	28	3.20	.53	.06	19	2.20	.37	-.34
6	15	2.70	.45	-.10	17	3.10	.52	.05	8	1.80	.30	-.50	5	1.25	.21	-.68
7	10	1.95	.32	-.43	21	2.25	.37	-.33	9	1.40	.23	-.62	12	1.00	.17	-.75
8	17	1.45	.24	-.59	15	1.20	.20	-.69	12	.95	.16	-.86	6	.40	.07	-1.00
9	12	.60	.10	-.94	9	.45	.07	-1.00	7	.35	.06	-.99	2	.10	.02	-1.06
Group 5 (n = 15) (Label-Plus-Rule):																
0	7	6.00	1.00	1.07	5	6.00	1.00	1.07	7	6.00	1.00	1.07	11	6.00	1.00	1.07
1	0	5.53	.92	.96	3	5.67	.94	1.00	2	5.53	.92	.94	7	5.27	.88	.83
2	9	5.53	.92	.96	1	5.47	.91	.95	4	.40	.90	.90	3	4.80	.80	.66
3	10	4.93	.82	.78	5	5.40	.90	.95	6	5.13	.86	.83	8	4.60	.77	.59
4	12	4.27	.71	.51	11	5.07	.84	.80	23	4.73	.79	.71	20	4.07	.68	.36
5	16	3.47	.58	.17	20	4.33	.72	.53	21	3.20	.53	.10	16	2.73	.46	-.15
6	16	2.40	.40	-.26	11	3.00	.50	-.02	8	1.80	.30	-.48	3	1.67	.28	-.51
7	11	1.33	.22	-.72	8	2.27	.38	-.31	11	1.27	.21	-.67	5	1.47	.24	-.55
8	4	.60	.10	-.95	14	1.73	.29	-.55	3	.53	.09	-.90	9	1.13	.19	-.68
9	5	.33	.06	-1.00	12	.80	.13	-.85	5	.33	.06	-.95	8	.53	.09	-.88
Group 6 (n = 13) (Exposure-Control):																
0	6	6.00	1.00	1.07	4	6.00	1.00	1.07	4	6.00	1.00	1.07	5	6.00	1.00	1.07
1	2	5.54	.92	.99	1	5.69	.95	.97	4	5.69	.95	1.00	3	5.62	.94	.99
2	2	5.38	.90	.94	8	5.62	.94	.96	3	5.38	.90	.91	4	5.38	.90	.88
3	7	5.23	.87	.92	1	5.00	.83	.76	7	5.15	.86	.80	11	5.08	.85	.79
4	15	4.69	.78	.75	9	4.92	.82	.71	18	4.62	.77	.58	10	4.23	.71	.48
5	18	3.54	.59	.22	21	4.23	.71	.53	18	3.23	.54	.12	15	3.46	.58	.23
6	8	2.15	.36	-.36	11	2.62	.44	-.16	8	1.85	.31	-.44	10	2.31	.38	-.25
7	9	1.54	.26	-.63	4	1.77	.29	-.47	6	1.23	.21	-.72	5	1.54	.26	-.53
8	8	.85	.14	-.79	11	1.46	.24	-.59	8	.77	.13	-.86	10	1.15	.19	-.71
9	3	.23	.04	-1.01	8	.62	.10	-.94	2	.15	.03	-1.02	5	.38	.06	-.93

f = frequency; cf = cumulative frequency; cp = cumulative probability; z = standard z-score transformations.

APPENDIX E

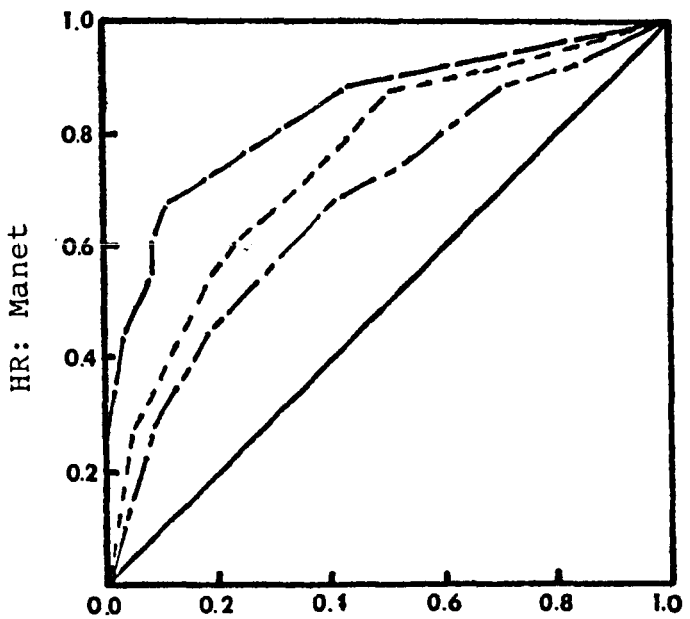
GRAPHS OF ROC FUNCTIONS

Immediate Concept Generalization



FAR: Renoir, Degas, Lautrec

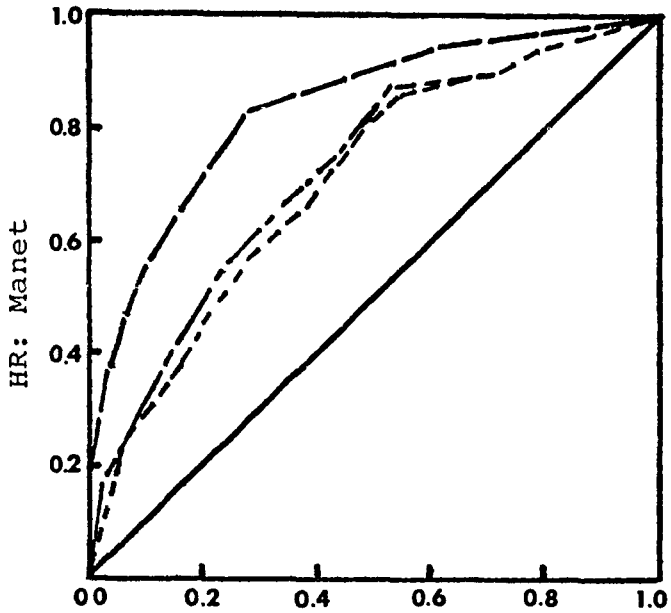
Group 1: Active label-only



FAR: Renoir, Degas, Lautrec

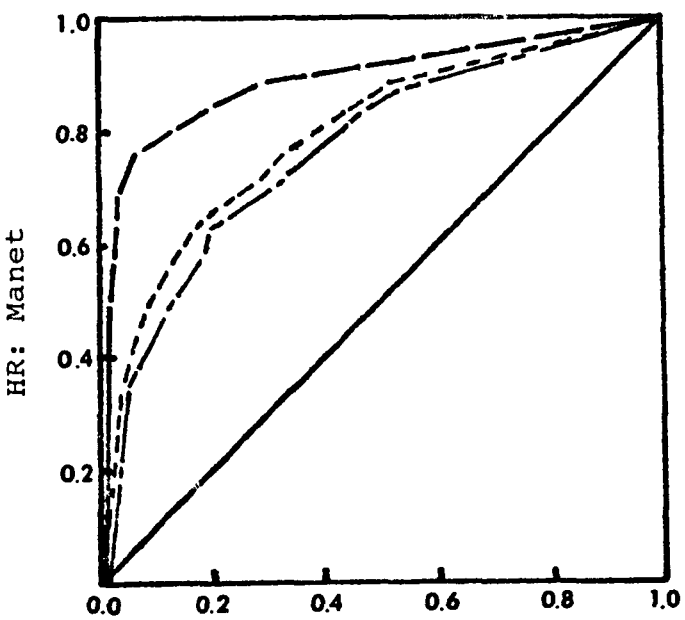
Group 2: Active label-plus-rule

Immediate Concept Generalization--Continued



FAR: Renoir, Degas, Lautrec

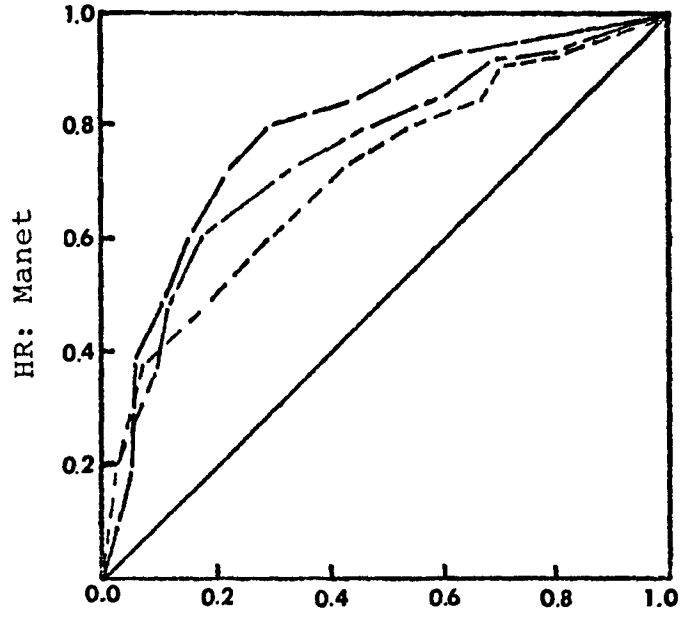
Group 4: Passive label-only



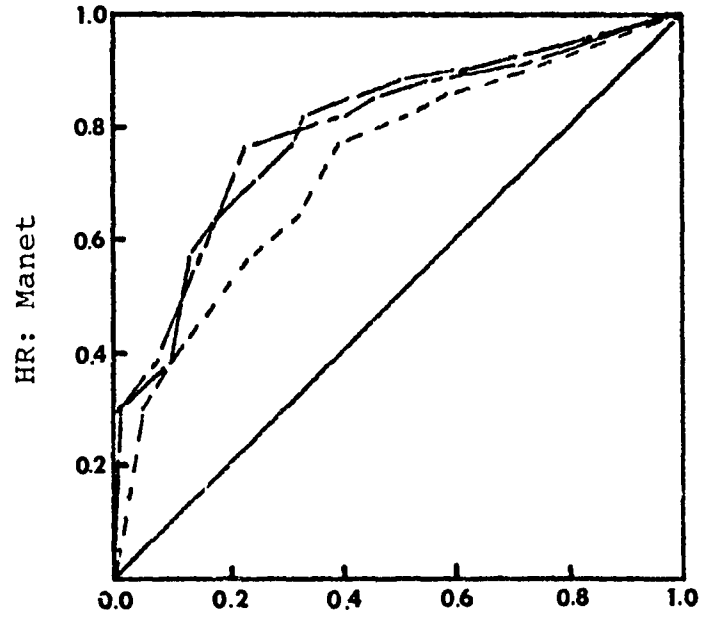
FAR: Renoir, Degas, Lautrec

Group 5: Passive label-plus-rule

Concept Retention and Delayed Generalization, Combined Data

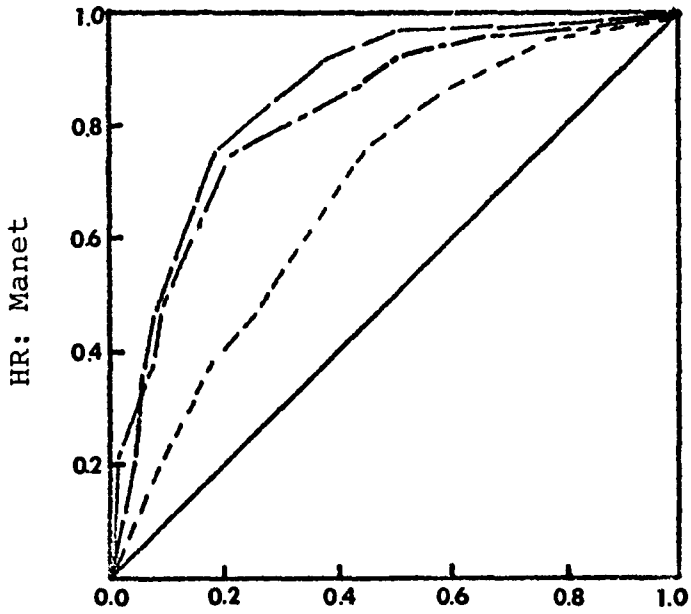


FAR: Renoir, Degas, Lautrec
Group 1: Active label-only



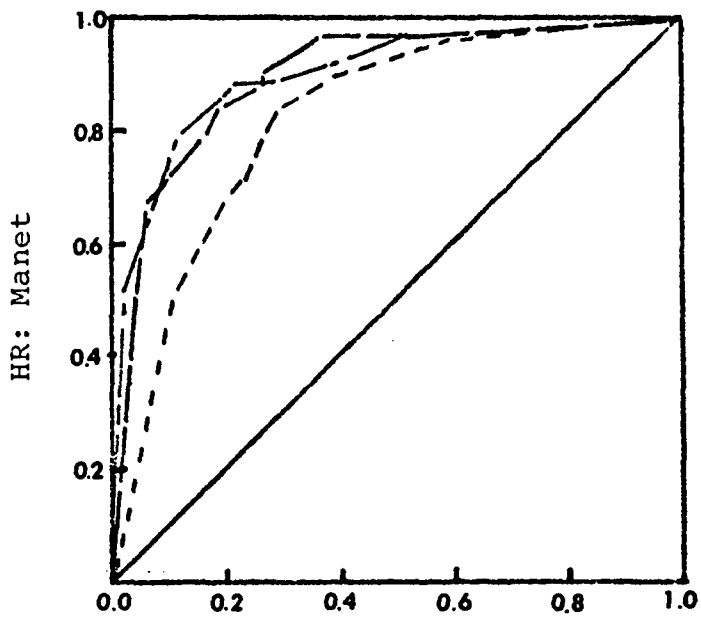
FAR: Renoir, Degas, Lautrec
Group 2: Active label-plus-rule

Concept Retention and Delayed Generalization--Continued



FAR: Renoir, Degas, Lautrec

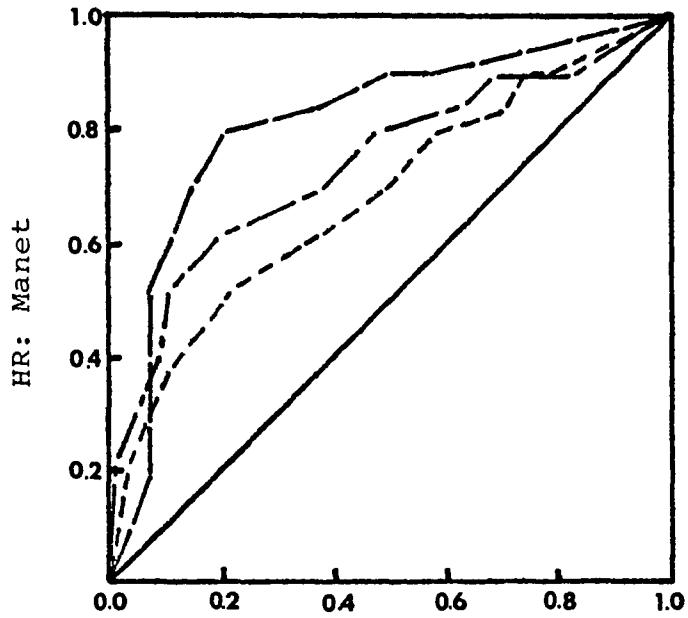
Group 4: Passive label-only



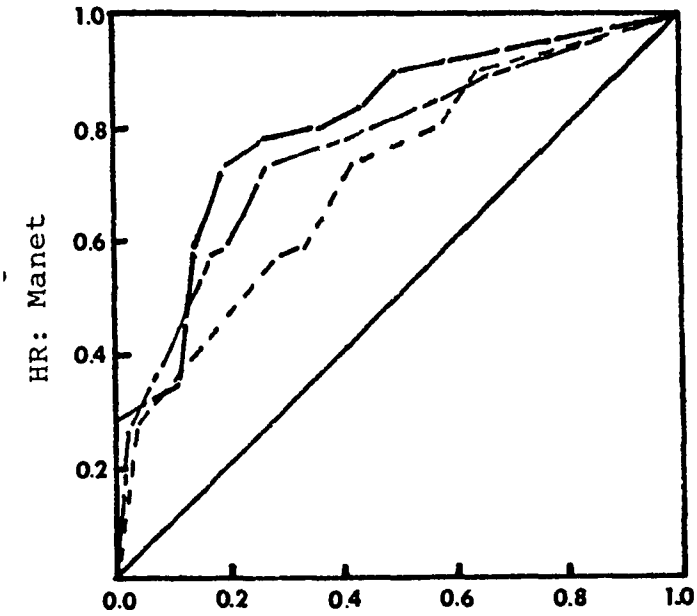
FAR: Renoir, Degas, Lautrec

Group 5: Passive label-plus-rule

Concept Retention

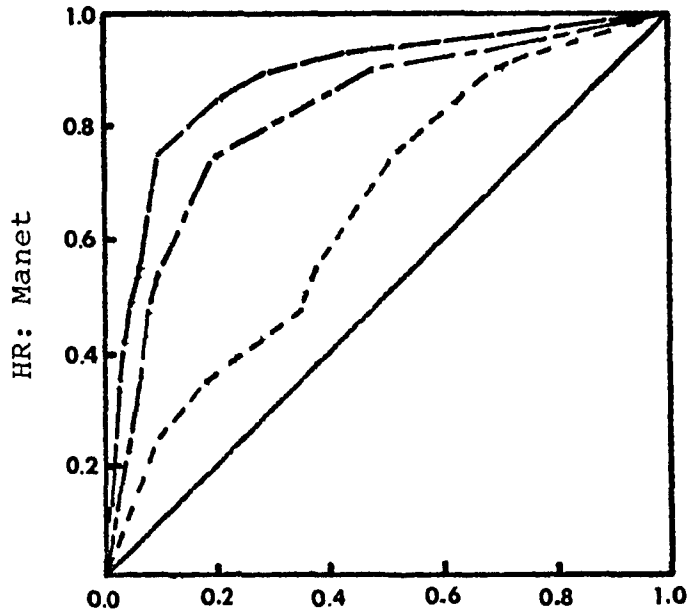


Group 1: Active label-only

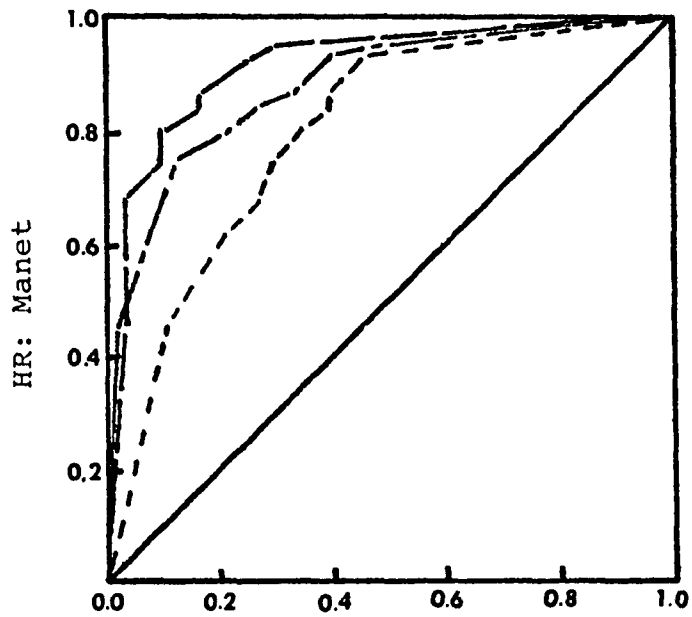


Group 2: Active label-plus-rule

Concept Retention--Continued

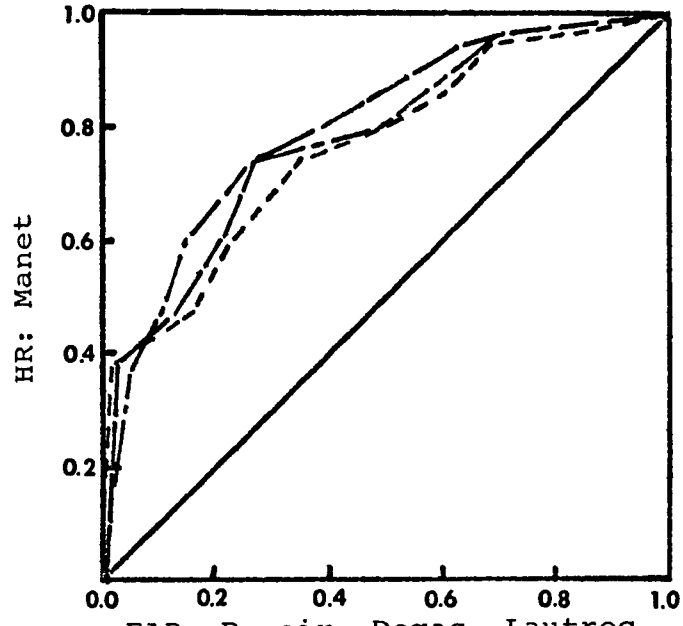


Group 4: Passive label-only

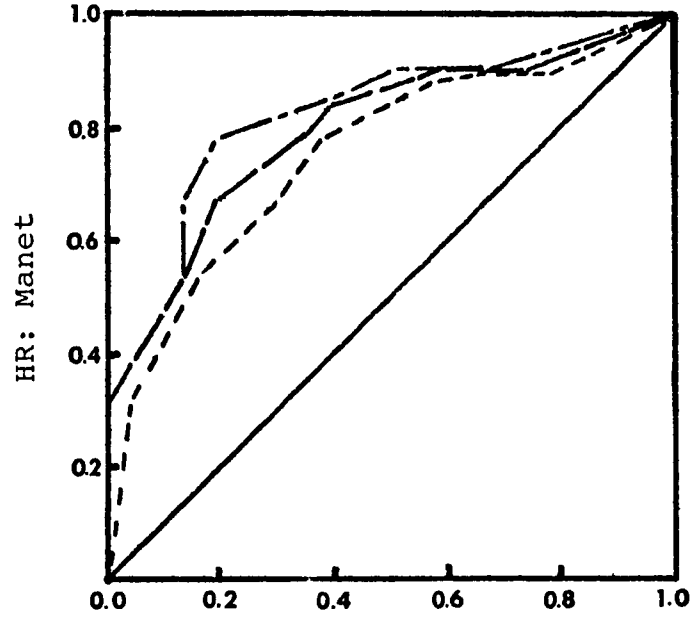


Group 5: Passive label-plus-rule

Delayed Generalization

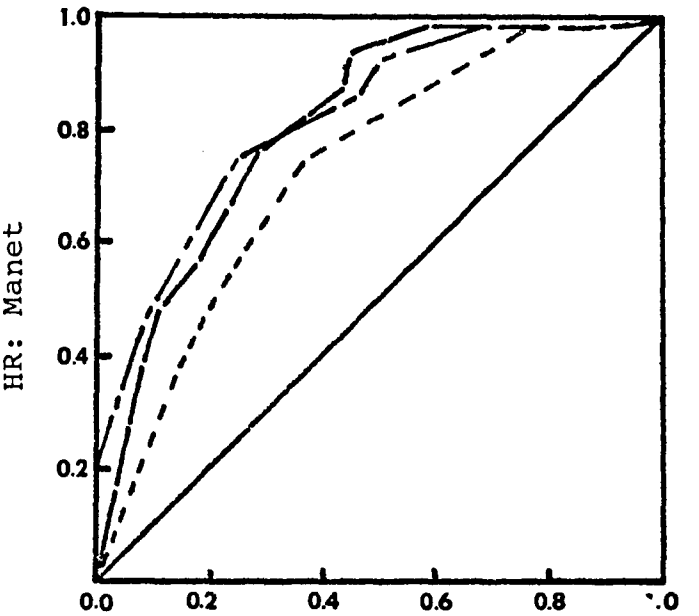


Group 1: Active label-only



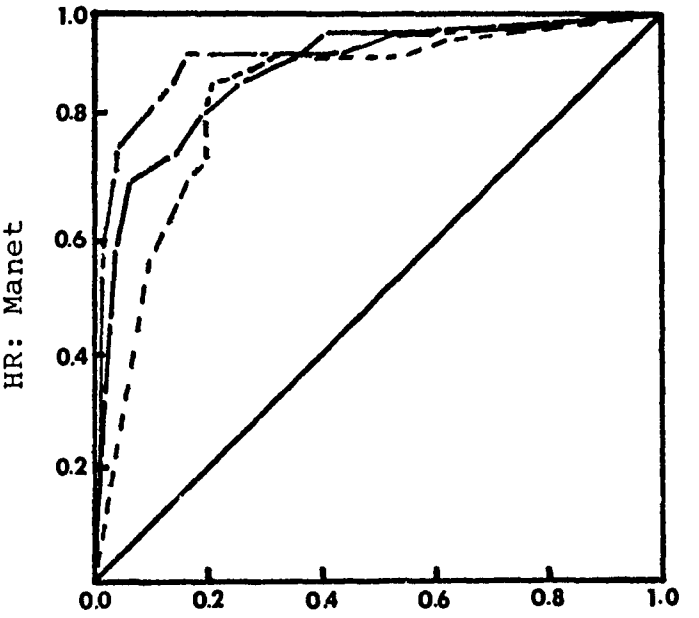
Group 2: Active label-plus-rule

Delayed Generalization--Continued



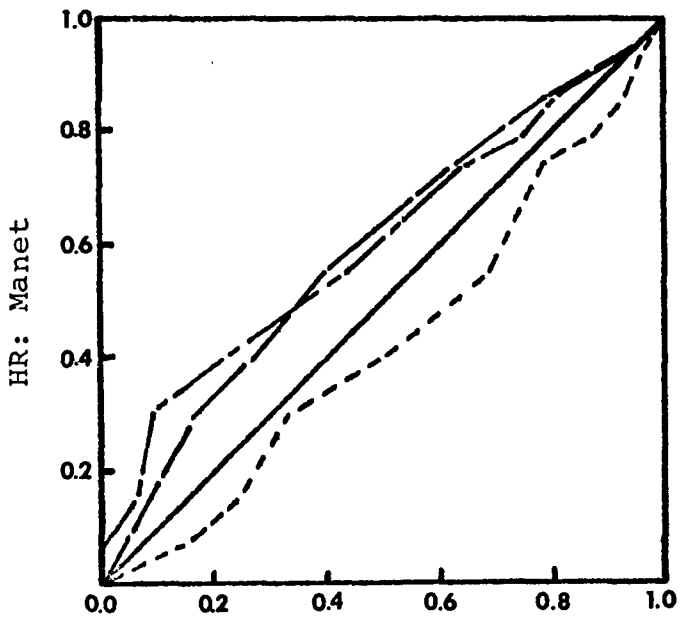
FAR: Renoir, Degas, Lautrec

Group 4: Passive label-only

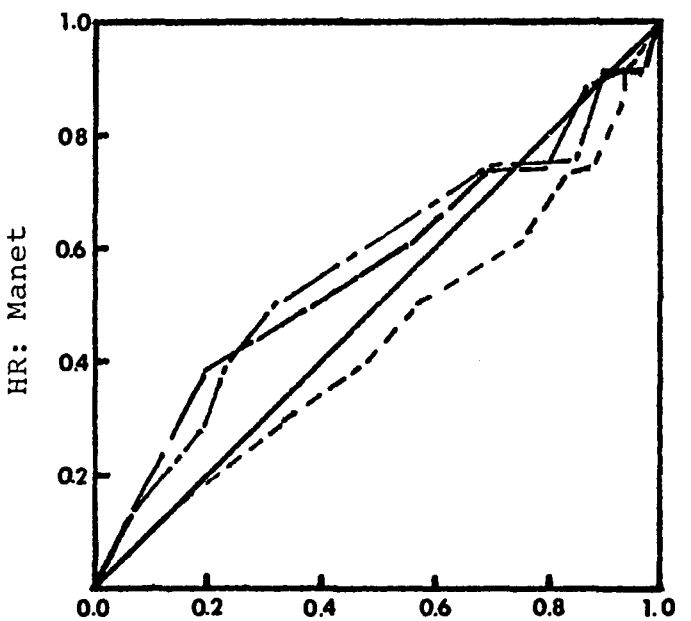


FAR: Renoir, Degas, Lautrec

Group 5: Passive label-plus-rule

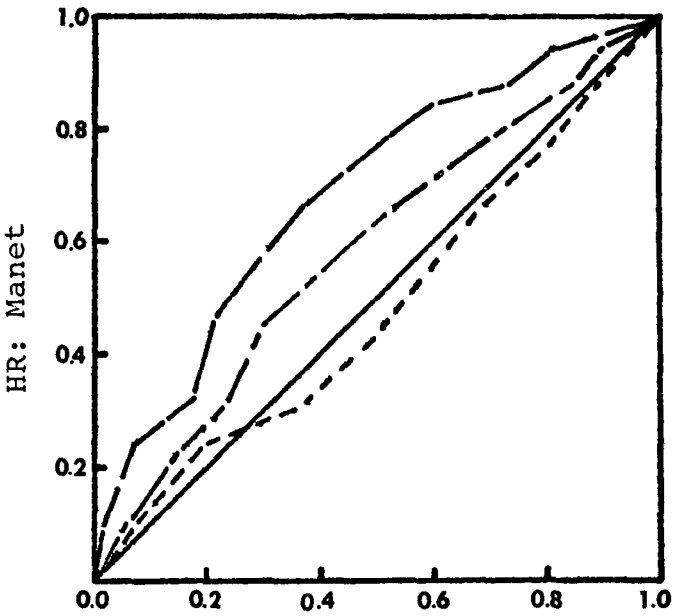


Group 1: Active label-only

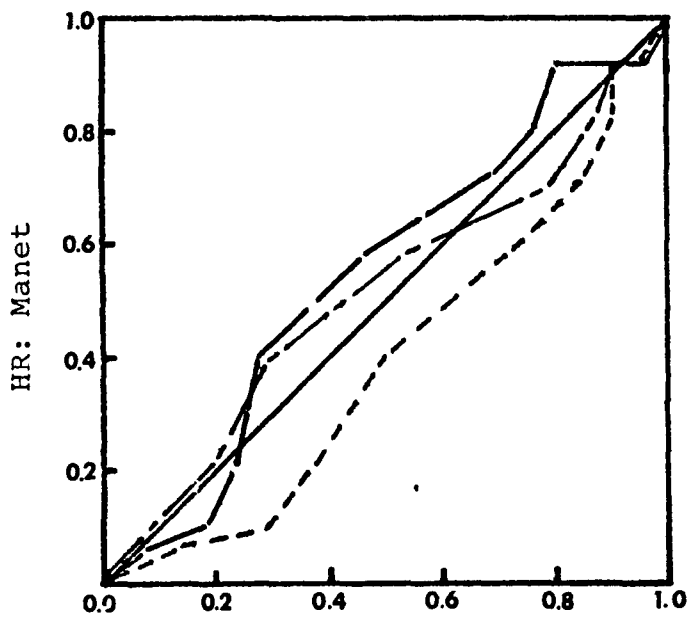


Group 2: Active label-plus-rule

Aesthetic Preference--Continued



FAR: Renoir, Degas, Lautrec
Group 4: Passive label-only



FAR: Renoir, Degas, Lautrec
Group 5: Passive label-plus-rule

APPENDIX F

OBSERVER INFORMATION

Training Instructions, Active Label-Only
(Group 1)

NAME_____

HAVE YOU TAKEN HUMANITIES? YES___ NO___

ART 7 YES___ NO___ ART 8? YES__ NO__

ART HISTORY OTHER THAN 7 OR 8?

WHAT KIND?_____

I'm asking you to participate in an art learning experiment. The purpose of the experiment is to find out which kind of learning situation is the most efficient.

During the learning period, you will see a series of 20 slides of paintings. They are painted by four different artists: Degas, Renoir, Lautrec, and Manet. There are five paintings by each artist.

Each slide will remain on the screen for 15 seconds. Look carefully at each one. The entire series will be repeated three times in exactly the same order.

You have three answer sheets, one for each of the three series. The sheet is numbered from 1 to 20. As soon as each slide appears, you have 10 seconds to write the name of the painter who made that picture. If you aren't sure, guess. After you have responded, you will be told the name of the painter whose work you are seeing. Each time a new series begins, use a fresh answer sheet,

Upon completion of the third series, you will be asked to identify slides of different paintings. The new paintings will have been done by these same four artists, but you will not have seen them before.

Training Instructions, Active Label-Plus-Rule
(Group 2)

NAME_____

Have you taken Humanities? YES___ NO___
Art 7? YES___ NO___
ART 8? YES___ NO___
Art History other than 7 or 8? What kind?
_____

I'm asking you to participate in an art learning experiment. The purpose of the experiment is to find out which kind of learning situation is the most efficient.

During the learning period, you will see a series of 20 slides of paintings. They are painted by four different artists: Degas, Renoir, Lautrec, and Manet. There are five paintings by each artist.

Each slide will remain on the screen for 15 seconds. Look carefully at each one. The entire series will be repeated three times in exactly the same order.

You have three answer sheets, one for each of the three series. The sheet is numbered from 1 to 20. As soon as each slide appears, you have 10 seconds to write the name of the painter who made that picture. Also, write one or two things that characterize his style. If you aren't sure, guess. After you have responded, you will be told the name of the painter whose work you are seeing. Each time a new series begins, use a fresh answer sheet.

Upon completion of the third series, you will be asked to identify slides of different paintings. The new paintings will have been done by these same four artists, but you will not have seen them before.

Training Instructions, Active Control (Group 3)

NAME_____

Have you taken Humanities? YES___ NO___
Art 7? YES___ NO___
Art 8? YES___ NO___
Art History other than 7 or 8? What kind?
_____

I'm asking you to participate in an art learning experiment. The purpose of the experiment is to find out which kind of learning situation is the most efficient.

During the learning period, you will see a series of 20 slides of paintings. They are painted by four different artists: Degas, Renoir, Lautrec, and Manet. There are five paintings by each artist.

Each slide will remain on the screen for 15 seconds. Look carefully at each one. The entire series will be repeated three times in exactly the same order.

You have three answer sheets, one for each of the three series. The sheet is numbered from 1 to 20. As soon as each slide appears, you have 15 seconds to write the name of the painter who made that picture. If you aren't sure, guess. Each time a new series begins, use a fresh sheet.

Upon completion of the third series, you will be asked to identify slides of different paintings. The new paintings will have been done by these same four artists, but you will not have seen them before.

Training Instructions, Passive
Label-Only (Group 4)

NAME_____

Have you taken Humanities? YES___ NO___
Art 7? YES___ NO___
Art 8? YES___ NO___
Art History other than 7 or 8? What kind?
_____

I'm asking you to participate in an art learning experiment. The purpose of the experiment is to find out which kind of learning situation is the most efficient.

During the learning period, you will see a series of 20 slides of paintings. They are painted by four different artists: Degas, Renoir, Lautrec, and Manet. There are five paintings by each artist.

Each slide will remain on the screen for 15 seconds. Look carefully at each one. The entire series will be repeated three times in exactly the same order.

During the time each slide appears on the screen, you will be told the name of the painter whose work you are seeing.

Upon completion of the third series, you will be asked to identify slides of different paintings. The new paintings will have been done by these same four artists, but you will not have seen them before.

Training Instructions, Passive
Label-Plus-Rule (Group 5)

NAME_____

Have you taken Humanities? YES___ NO___
Art 7? YES___ NO___
Art 8? YES___ NO___
Art History other than 7 or 8? What kind?
_____

I'm asking you to participate in an art learning experiment. The purpose of the experiment is to find out which kind of learning situation is the most efficient.

During the learning period, you will see a series of 20 slides of paintings. They are painted by four different artists: Degas, Renoir, Lautrec, and Manet. There are five paintings by each artist.

Each slide will remain on the screen for 15 seconds. Look carefully at each one. The entire series will be repeated three times in exactly the same order.

During the time each slide appears on the screen, you will be told the name of the painter whose work you are seing. You will also be told one or two things that characterize his style.

Upon completion of the third series, you will be asked to identify slides of different paintings. The new paintings will have been done by these same four artists, but you will not have seen them before.

Training Instructions, Passive Control (Group 6)

NAME_____

Have you taken Humanities? YES___ NO___
Art 7? YES___ NO___
Art 8? YES___ NO___
Art History other than 7 or 8? What kind?
_____

I'm asking you to participate in an art learning experiment. The purpose of the experiment is to find out which kind of learning situation is the most efficient.

During the learning period, you will see a series of 20 slides of paintings. They are painted by four different artists: Degas, Renoir, Lautrec, and Manet. There are five paintings by each artist.

Each slide will remain on the screen for 15 seconds. Look carefully at each one. The entire series will be repeated three times in exactly the same order.

Upon completion of the third series, you will be asked to identify slides of different paintings. The new paintings will have been done by these same four artists, but you will not have seen them before.

Immediate Generalization
Answer Sheet

You are about to look at slides of paintings that you have not seen before. Some of these paintings are the work of the artist Manet. As each slide appears on the screen, you are to express on this answer sheet the level of your confidence that the slide either is or is not the work of the painter Manet.

Below is a rating scale. Each number on the scale stands for a distinguishable degree of confidence concerning whether or not you are viewing the work of Manet. Write on the answer sheet the number that most nearly expresses your feeling about whether the slide is or is not the work of Manet. Take your time, and answer on the basis of how confident you feel. Each slide will remain on the screen for 10 seconds.

Confidence Scale

0 I am absolutely certain that this is NOT the work of Manet
1 More than "fairly certain"--not Manet
2 Fairly certain--not Manet
3 More than "just guessing"--not Manet
4 Just guessing--not Manet

5 Just guessing--it is Manet
6 More than "just guessing"--is Manet
7 Fairly certain--is Manet
8 More than "fairly certain"--is Manet
9 I am absolutely certain that this IS the work of Manet

1. _____	11. _____	21. _____	31. _____
2. _____	12. _____	22. _____	32. _____
33. _____	13. _____	23. _____	33. _____
4. _____	14. _____	24. _____	34. _____
5. _____	15. _____	25. _____	35. _____
6. _____	16. _____	26. _____	36. _____
7. _____	17. _____	27. _____	37. _____
8. _____	18. _____	28. _____	38. _____
9. _____	19. _____	29. _____	39. _____
10. _____	20. _____	30. _____	40. _____

Name _____

Concept Retention and Delayed Generalization
Answer Sheet

You are about to look at slides of paintings that you have not seen before. Some of these paintings are the work of the artist Manet. As each slide appears on the screen, you are to express on this answer sheet the level of your confidence that the slide either is or is not the work of the painter Manet.

Below is a rating scale. Each number on the scale stands for a distinguishable degree of confidence concerning whether or not you are viewing the work of Manet. Write on the answer sheet the number that most nearly expresses your feeling about whether the slide is or is not the work of Manet. Take your time, and answer on the basis of how confident you feel.

Each slide will remain on the screen for 10 seconds.

Confidence Scale

0 I am absolutely certain that this is NOT the work of Manet
1 More than "fairly certain"--not Manet
2 Fairly certain--not Manet
3 More than "just guessing"--not Manet
4 Just guessing--not Manet

5 Just guessing--it is Manet
6 More than "just guessing"--is Manet
7 Fairly certain--is Manet
8 More than "fairly certain"--is Manet
9 I am absolutely certain that this IS the work of Manet

1. _____	11. _____	21. _____	31. _____
2. _____	12. _____	22. _____	32. _____
3. _____	13. _____	23. _____	33. _____
4. _____	14. _____	24. _____	34. _____
5. _____	15. _____	25. _____	35. _____
6. _____	16. _____	26. _____	36. _____
7. _____	17. _____	27. _____	37. _____
8. _____	18. _____	28. _____	38. _____
9. _____	19. _____	29. _____	39. _____
10. _____	20. _____	30. _____	40. _____

Name _____

Training Slide Recall Answer Sheet

NAME_____

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

Aesthetic Preference Answer Sheet

You are about to look at slides of paintings that you have seen before. They are the works of four painters: Degas, Renoir, Lautrec, and Manet.

As each slide appears on the screen, please express on this answer sheet your aesthetic preference--whether you like the painting or whether you dislike it, as a work of art.

Below is a rating scale. Write on the answer sheet the number that most nearly expresses your feeling about whether you like or dislike the slide that you are seeing.

Preference Scale

0 I DISLIKE this painting very much.
1 More than "fairly certain"--dislike it.
2 Fairly certain--I dislike it.
3 More than "lukewarm"--dislike it.
4 Just lukewarm--but I dislike it.

5 Just lukewarm--but I like it.
6 More than "lukewarm"--like it.
7 Fairly certain--I like it.
8 More than "fairly certain"--like it.
9 I LIKE this painting very much.

1. _____	9. _____	17. _____
2. _____	10. _____	18. _____
3. _____	11. _____	19. _____
4. _____	12. _____	20. _____
5. _____	13. _____	21. _____
6. _____	14. _____	22. _____
7. _____	15. _____	23. _____
8. _____	16. _____	24. _____

Name _____

Elicited Relevant Attributes
Answer Sheet

Name_____

I. MANET. What makes this look like Manet?

II. RENOIR. What makes this look like Renoir?

III. DEGAS. What makes this look like Degas?

IV. LAUTREC. What makes this look like Lautrec?

APPENDIX G

ELICITED RELEVANT ATTRIBUTES

Content Analysis

Elicited criteria from the four training groups were analyzed by the experimenter and grouped according to content. No attempt was made to check the reliability of the experimenter's judgment by having more than one person score the responses.

Responses were divided into the following three categories: (1) rules learned by the label-plus-rule condition during training and repeated back to the experimenter during the test; (2) criteria not taught during training, observed and reported solely by the label-only condition; and (3) criteria reported predominantly by the label-only condition, but mentioned with varying frequency by all training groups.

Levels of Information:
Label-Plus-Rule

Subjects in Groups 2 and 5 responded to the request for criteria by repeating the rules they had learned during training. Group 5 subjects (passive) repeated more rules in sixty per cent of the responses than did Group 2 (active) subjects. Seven out of nine rules reported by the two

label-plus-rule groups were not reported at all by the label-only groups. Only two rules taught during training apparently dealt with characteristics so obvious to the untrained eye that even the label-only groups reported them. These were the emotional content of Renoir, and Lautrec's use of vertical or black lines.

Label-Only

Twenty-three characteristics were identified in addition to those taught to label-rule groups. Three of these were reported solely by label-only groups and were not observed by the label-plus-rule groups. One of these characteristics refers to the uncluttered background of Manet, one to the clear facial expressions of Degas, and one to the caricature-like quality of Lautrec. Comparison of these three with the seven criteria reported only by the label-rule groups seems to exclude the possibility that the label-only groups devised their own vocabulary for phenomena described by the rules taught during training. Each of these three characteristics seems to be a distinct, new category.

By far the greater number of spontaneously generated criteria were discovered both by label-plus-rule and by label-only groups, with higher frequencies reported by label-only groups. The only label-rule group that

occasionally predominated was Group 5 (passive label-plus-rule), and this occurred in only three cases out of twenty-three.

Active-Passive

Group 4 (passive label-only) reported higher frequencies for more criteria than Group 1 (active label-only) did. Group 1 scored high at least once for each artist, however, and twice for Degas, on a total of five different criteria. Group 4, in contrast, scored highest on seven separate characteristics, but five of these were concerned specifically with Manet.

Artists

Frequency of elicited attributes, as functions of artists, corresponded to the artists' perceived distance from the target artist Manet on the immediate generalization and concept retention tests. Manet was the stimulus that generated the most observations, apparently a direct result of his being the focus of subjects' attention (Figure 32). Lautrec, most easily distinguished from Manet, elicited the next greatest number. Renoir and Degas yielded proportionately fewer attributes, perhaps reflecting subjects' tendencies to perceive these artists as not quite so distinct from Manet as Lautrec. For each artist the number of predominantly label-only generated (spontaneous) attributes exceeded the label-plus-rule generated (learned) criteria.

For Lautrec, seventy-five per cent of reported attributes were generated by label-only subjects; for Manet the percentage of spontaneously generated criteria was seventy-seven. Even for Renoir and Degas the percentage ran 60 and 66, respectively.

Discussion

Levels of information as a training condition appears to have differentially affected subjects' abilities to generate attributes relevant to a concept of painting style. Giving subjects a verbal rule characterizing style suppressed the spontaneous generation of style defining criteria. The most reasonable explanation for this is that the rules taught during training were very efficient and the subjects did not need to look further.

Training Rule Condition

The following rules were taught to Groups 2 and 5 (label-plus-rule) during training.

Manet: His work is austere and deliberate; without shadows and with little depth.

Renoir: The sensuality of his art is evident in his color, his touch, and his subjects.

Degas: His deliberately off-center composition is as unstudied as a snapshot.

Lautrec: His decadent atmosphere depends on spatial diagonals, strong patterns of line, and dissonant color.

Rules were derived from the following authoritative sources:

Cleaver, D. Art: An Introduction. New York: Harcourt, Brace & World, Inc., 1966 (First Edition).

Croix, H. de la, and Tansey, R. G. Gardner's Art Through the Ages. New York: Harcourt, Brace & World, Inc., 1970.

Janssen, H. W. History of Art. Englewood Cliffs, N.J.: Prentice-Hall, Inc., and New York: Harry Abrams, Inc., 1965.

Read, H. A Concise History of Modern Painting. New York: Praeger, 1959.

Content Analysis of Attributes Elicited After Delay, Regardless of Strength of Response

1. Manet.

   a. General stylistic characteristics.

      (1) Emotional content: deliberate, austere.

      (2) No shadows.

      (3) Depth: little.

      (4) Contrast.

      (5) Clarity: clear, well-defined forms and lines; uncluttered; distinct; detailed; direct.

      (6) Texture: smooth; lack of brush strokes.

      (7) Photographic quality: detailed, accurate.

      (8) Subject matter: figures.

   b. Figures.

      (1) Stiffness: posed.

      (2) Light colors.

      (3) Realistic: accurate representation.

      (4) Clear detail; well defined.

   c. Faces.

      (1) Distinctively shaped faces and features.

      (2) Clear detail in faces.

      (3) Light-colored skin.

      (4) Smooth textured skin; lack of brush strokes.

      (5) Solemn expression; lack of expression.

   d. Color.

      (1) Drab: lack of color or intensity.

      (2) Clear: distinct; definite.

(3) Dark colors.

(4) Light colors.

(5) Warm, intense, rich, beautiful, positive, lifelike.

e. Background.

(1) Dark colors.

(2) Uncluttered: plain; little detail.

2. Renoir.

a. General stylistic characteristics.

(1) Soft appearance: hazy, blurry outlines; lack of outline; objects not distinct.

(2) Sensual.

(3) Emotional content: gentle, sweet, happy.

(4) Subject matter: female figures.

(5) Texture: visible brush strokes.

b. Figures.

(1) Facial expression: kind; sensitive; sweet

(2) Flesh color: warm; blushing.

(3) Softness.

c. Color.

(1) Pretty.

(2) Pastel.

(3) Hazy, fuzzy, blurred, soft.

(4) Warm.

(5) Expressing emotion: sweet, exciting, etc.

(6) Broken color; blending of colors.

(7) Cool, dull.

d. Background.

(1) Fuzzy.

e. Comparisons with Manet.

3. Degas.

a. General stylistic characteristics.

(1) Off-center composition.

(2) Unstudied, unposed, like a snapshot.

(3) Use of diagonal lines.

(4) Emotional content: serious, heavy, mournful, dull, boring, subtle.

(5) Contrast: faces with ground.

(6) Clarity.

(7) Texture.

(8) Photographic quality: detailed, accurate.

(9) Sketchiness.

(10) Depth.

(11) Subject matter: figures.

b. Figures.

(1) Dark clothing.

(2) Realistic: accurate representation.

c. Faces.

(1) Distinctively shaped faces and features.

(2) Clear facial expressions.

(3) Light faces contrast with the rest of the painting.

(4) Sad, gloomy expressions.

d. Color.

(1) Drab: lack of color or intensity; dull.

(2) Dark: gloomy, solemn, sinister.

(3) Use of black.

e. Background.

(1) Hazy, obscure; lack of detail.

f. Comparisons with Manet.

4. Lautrec.

a. General stylistic characteristics.

(1) Use of the diagonal.

(2) Setting: bar scenes, night life; seamy; common people.

(3) Vertical and/or black lines running throughout picture.

(4) Emotional content: sinister; unappealing; happy, gay.

(5) Contrast.

(6) Texture: visible brush strokes.

(7) Sketchiness: similar texture on all objects; unclear; lack of detail.

(8) Depth.

b. Figures.

(1) Groups of figures.

(2) Caricatured figures and facial expressions; fatter.

(3) Active figures.

(4) Unrealistic drawing; poster-type technique; not well defined.

c. Color.

(1) Dark colors: somber, earthy, not bright.

(2) Harsh: blacks, grays and oranges; dissonant combinations.

(3) Muted colors: grays and whites.

d. Background.

(1) Activity.

e. Comparisons with Manet.

Attributes Elicited After Delay Showing a Response Strength of 25% or More

Characteristic	Percentage of Response Training Groups 1	2	4	5
Manet				
A. Rules				
No shadows	0.0	.42	0.0	.53
Lack of depth	0.0	.42	0.0	.33
Deliberate, austere	0.0	.42	0.0	.20
B. Nonrules				
Uncluttered background	.05	0.0	.30	0.0
Clear detail, faces	.35	0.0	.25	.06
Distinctively shaped faces	.29	.14	0.0	.06
Texture	.17	0.0	.30	.06
Solemn expression	.17	.07	.25	.20
Light skin, faces	.11	0.0	.30	.06
Photographic quality (detail)	.11	.07	.30	.06
Realistic (not distorted)	.11	.07	.25	.06
Contrast	.23	.14	.15	.40
Clarity	.47	.35	.45	.53
Renoir				
A. Rules				
Emotional content	.23	.42	.25	.46
Sensual	0.0	.21	0.0	.26
B. Nonrules				
Pastel color	.35	.07	.20	0.0
Soft appearance	.82	.57	.55	.80
Hazy color	.29	.28	.20	.20
Degas				
A. Rules				
Off-center composition	0.0	.64	0.0	.80
Like a snapshot (not posed)	0.0	.34	0.0	.33

Characteristic	Percentage of Response Training Groups 1	2	4	5
B. Nonrules				
Clear expressions, features	.35	0.0	.25	0.0
Dark color	.47	.28	.35	.06
Emotional content	.29	.21	.20	0.0
Hazy, obscure background	.17	.14	.45	.26
Lautrec				
A. Rules				
Vertical and/or black lines	.23	.64	.20	.66
Use of diagonal	0.0	.28	0.0	.40
B. Nonrules				
Caricatured	.41	0.0	.10	0.0
Realistic-unrealistic	.35	.07	.15	0.0
Texture	.35	.07	.30	.13
Sketchiness	.41	.07	.40	.33
Setting	.23	.21	.40	.13
Dark color	.29	.21	.25	.20

Rule and Nonrule Behavior Plotted by Means of Bar Graphs

Rules: Criteria taught to Groups 2 and 5 during training and reported predominantly by Groups 2 and 5.

Nonrules: Criteria generated spontaneously (not taught during training) and reported predominantly by Groups 1 and 4.

Patterns of nonrule responses:

Groups 1 and 4 only respond.

All groups respond, with 1 and 4 predominant.

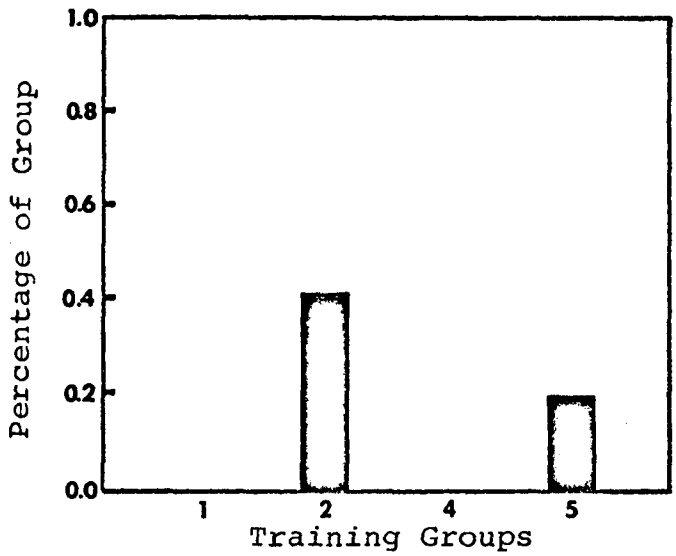
Group 1 predominant.

Group 4 predominant.

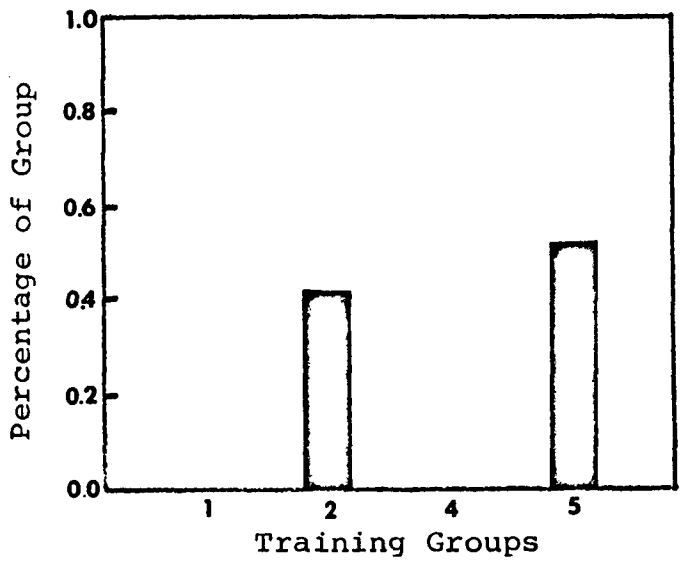
Groups 1 and 5 predominant.

All groups respond with approximately the same frequency.

Rules Taught During Training

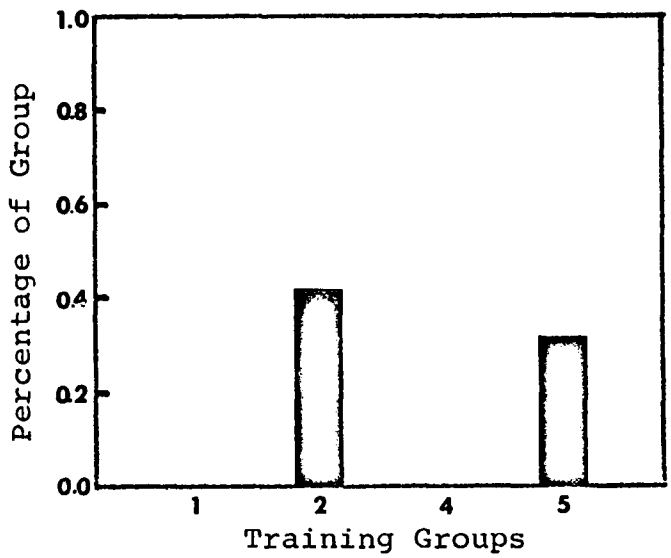


Manet: Deliberate, Austere

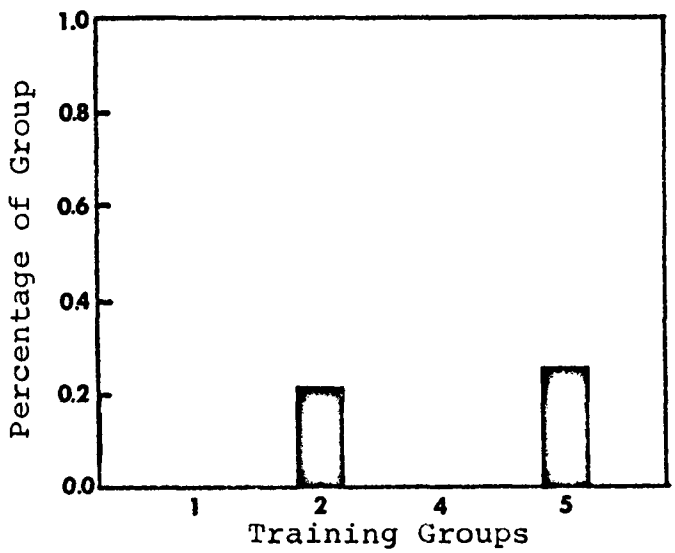


Manet: No Shadows

Rules Taught--Continued

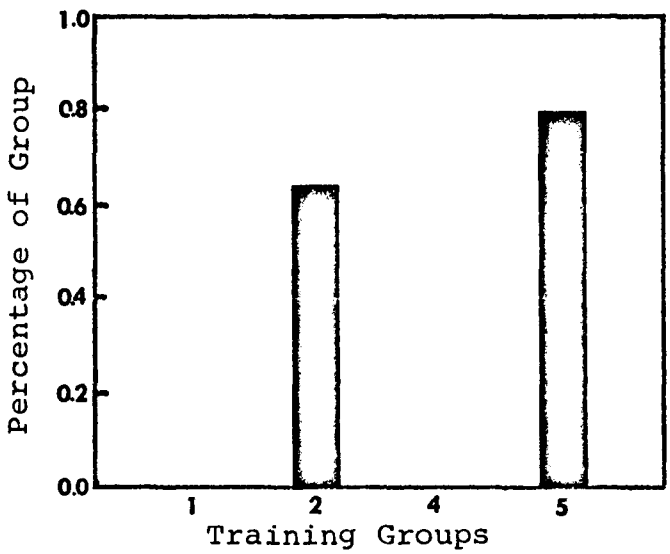


Manet: Lack of Depth

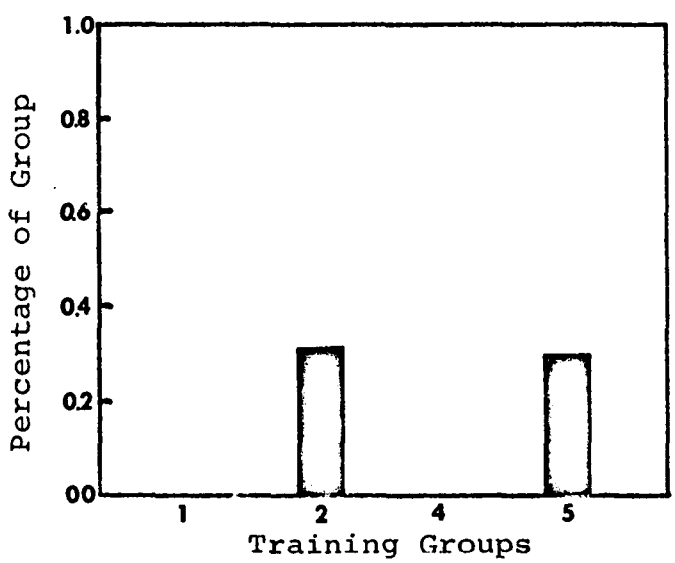


Renoir: Sensual

Rules Taught--Continued

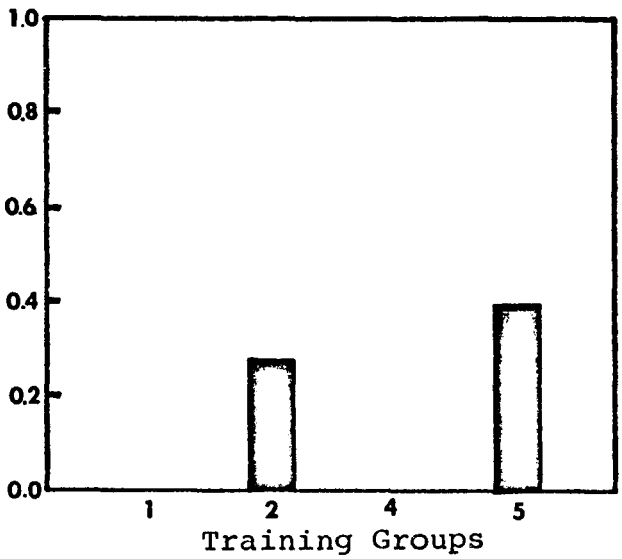


Degas: Off-center Composition

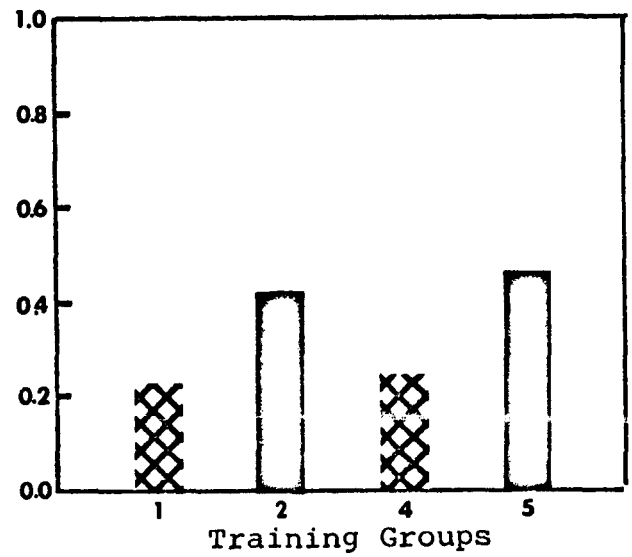


Degas: Like a Snapshot

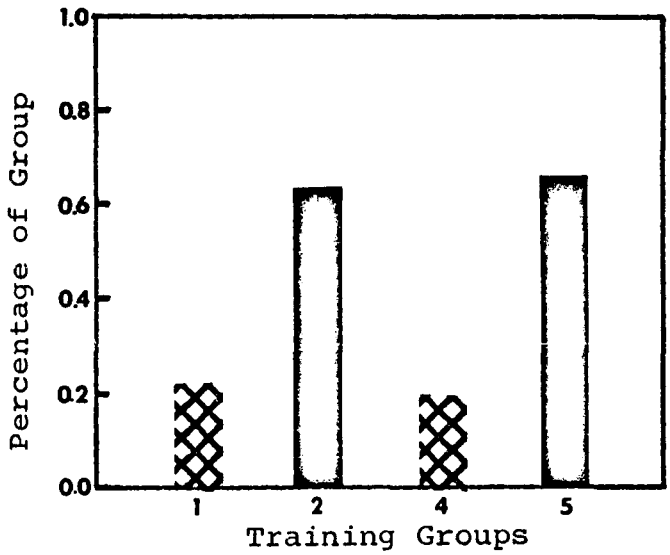
Rules Taught--Continued



Lautrec: Use of Diagonal

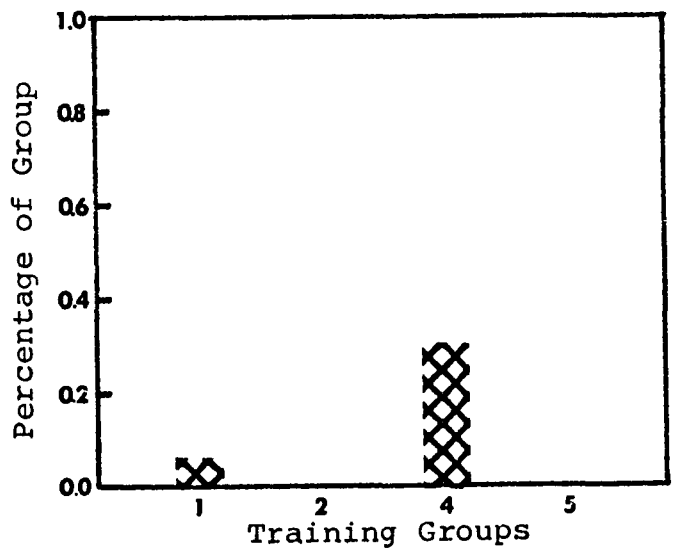


Renoir: Emotional Content



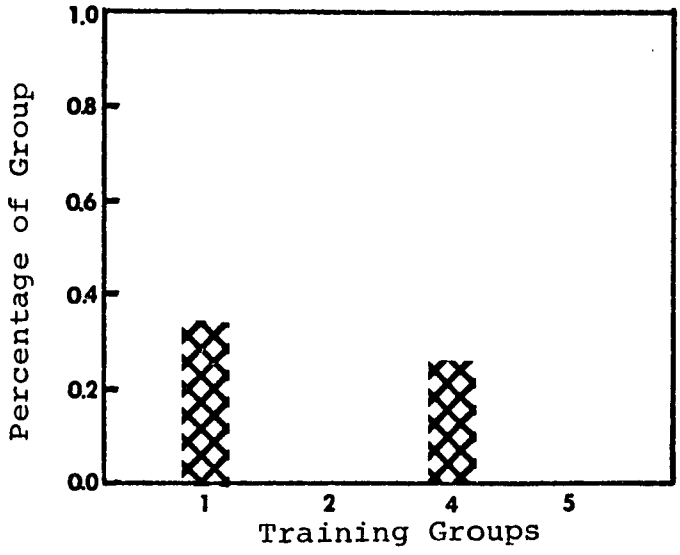
Lautrec: Vertical, Black Lines

Attributes generated by label-only training groups

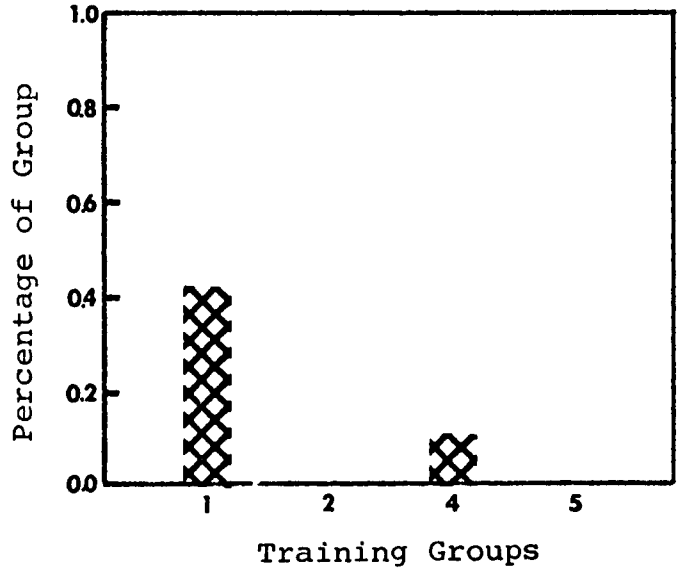


Manet: Uncluttered Background

Attributes generated, label-only--Continued

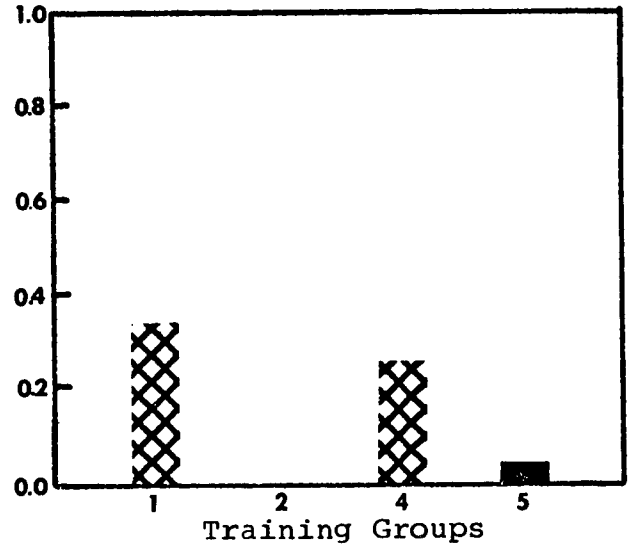


Degas: Clear Expressions, Features

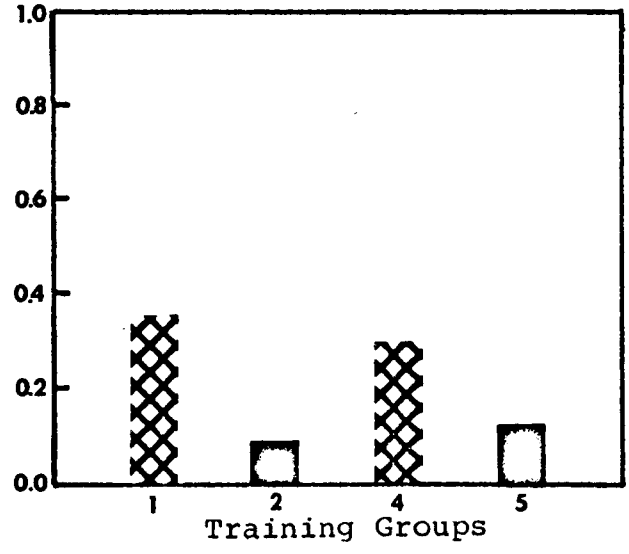


Lautrec: Caricatured

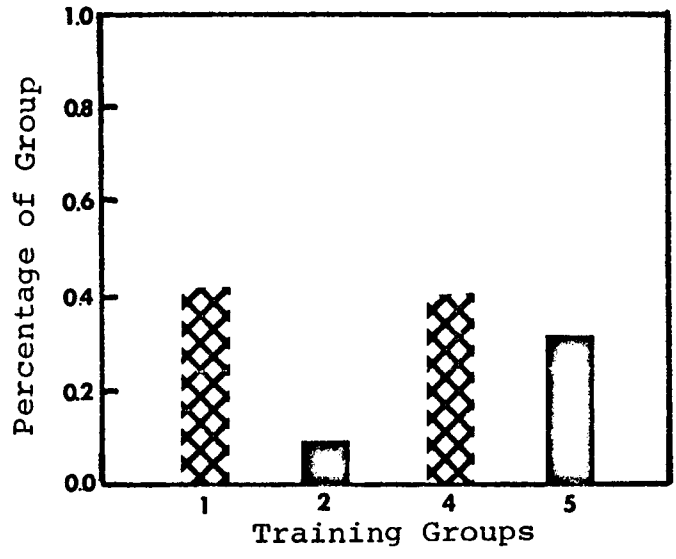
Attributes generated, label-only--Continued



Manet: Clear Detail, Faces

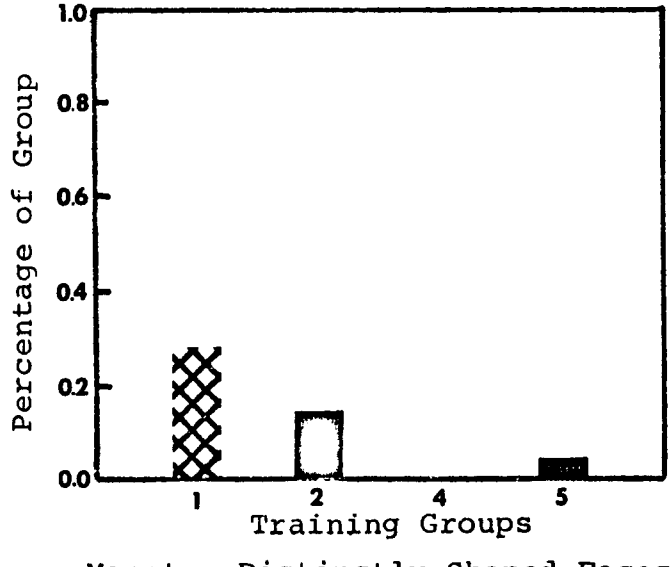


Lautrec: Texture



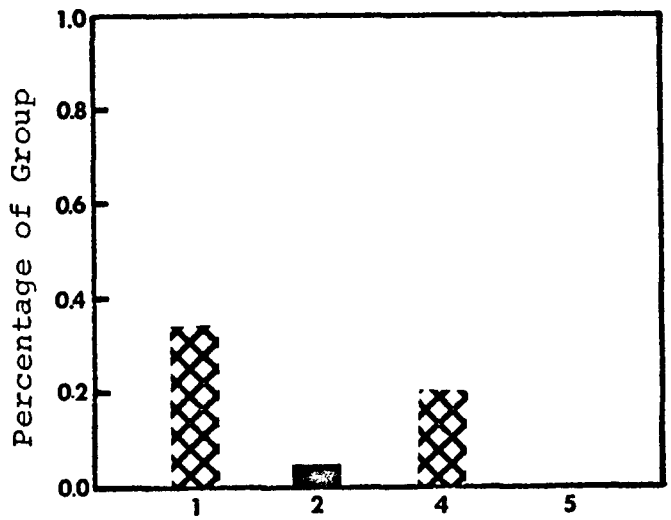
Lautrec: Sketchiness

Attributes generated predominantly by Group 1

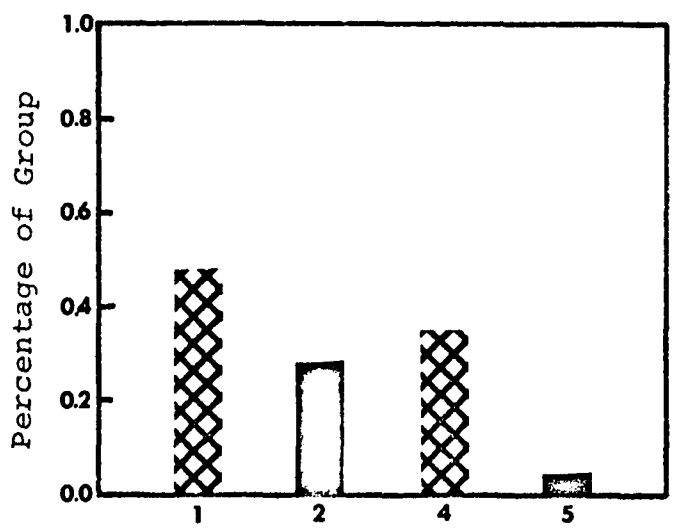


Manet: Distinctly Shaped Faces

Attributes generated, Group 1--Continued

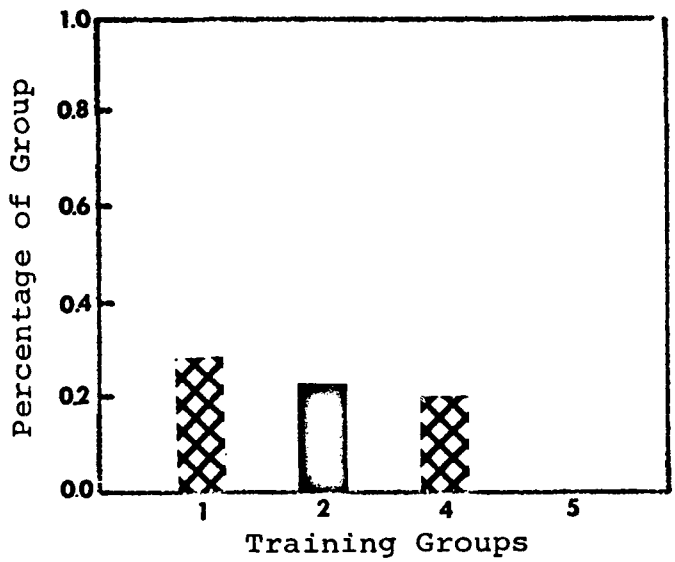


Renoir: Pastel Color

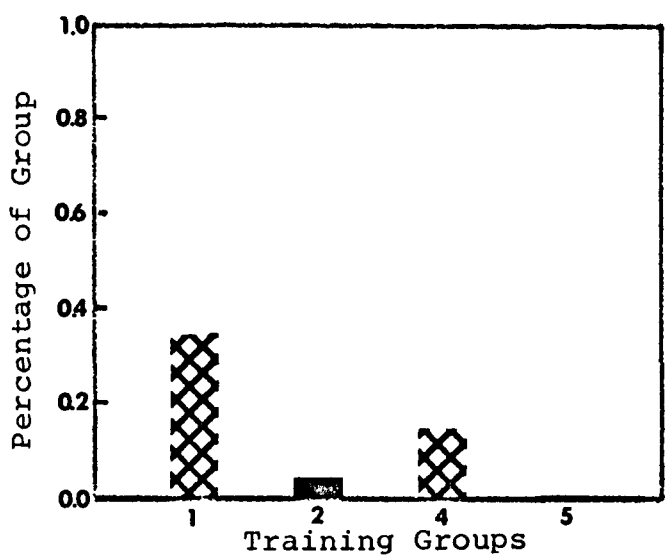


Degas: Dark Color

Attributes generated, Group 1--Continued

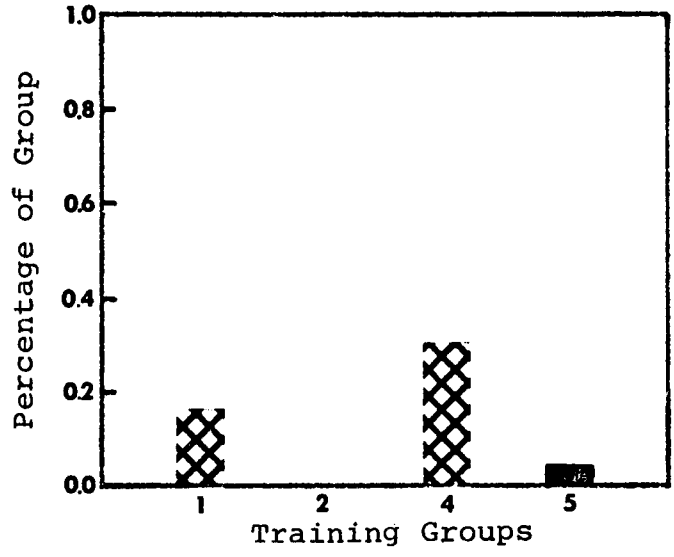


Degas: Emotional Content

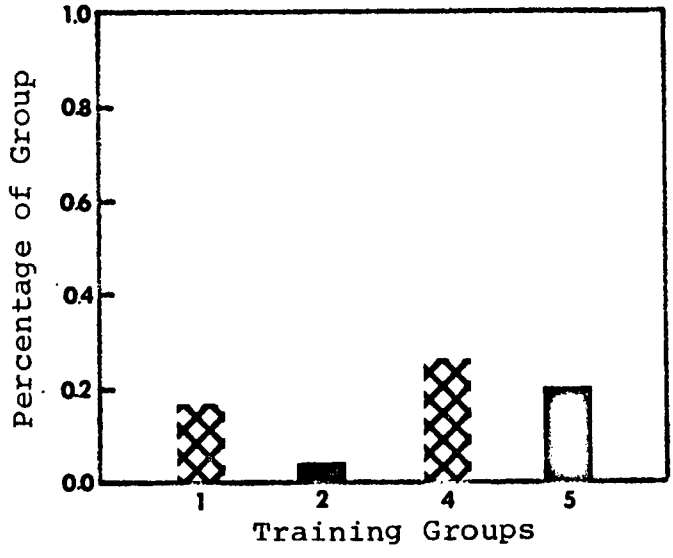


Lautrec: Realistic-Unrealistic

Attributes generated predominantly by Group 4

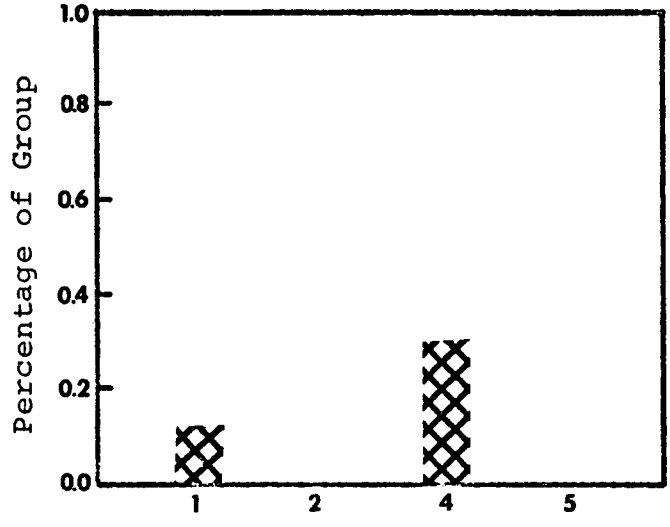


Manet: Texture

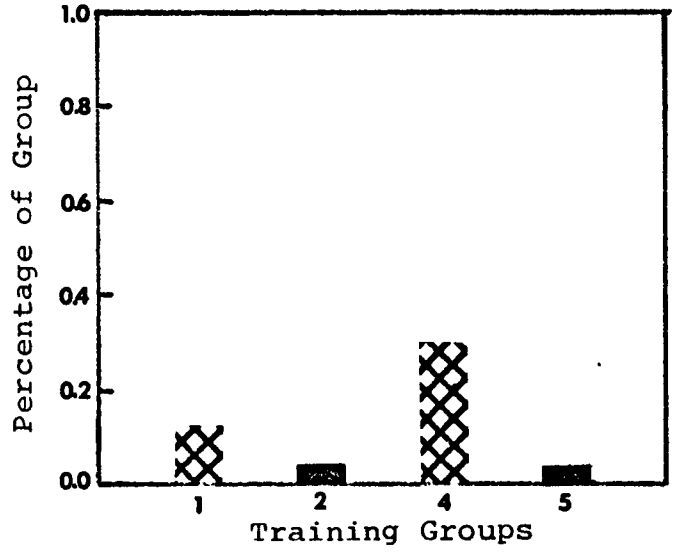


Manet: Solemn Expression

Attributes generated, Group 4--Continued

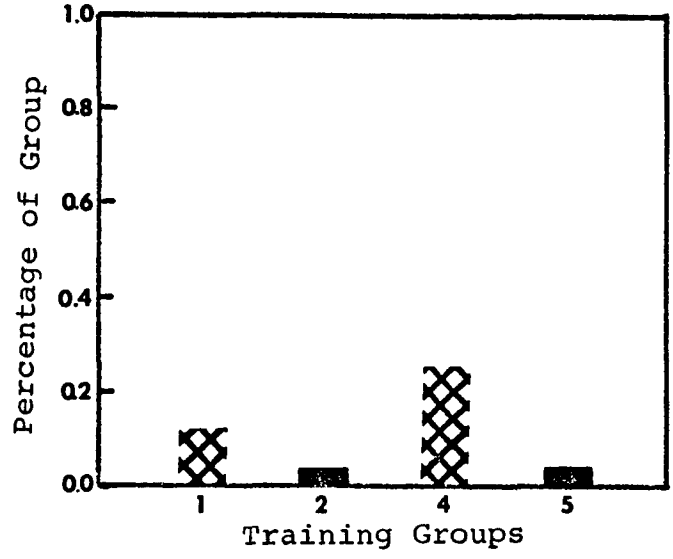


Manet: Light Skin, Faces

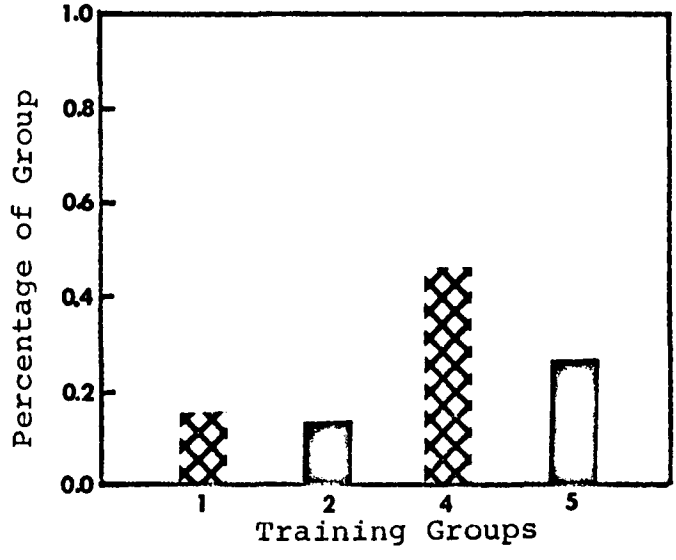


Manet: Photographic Quality

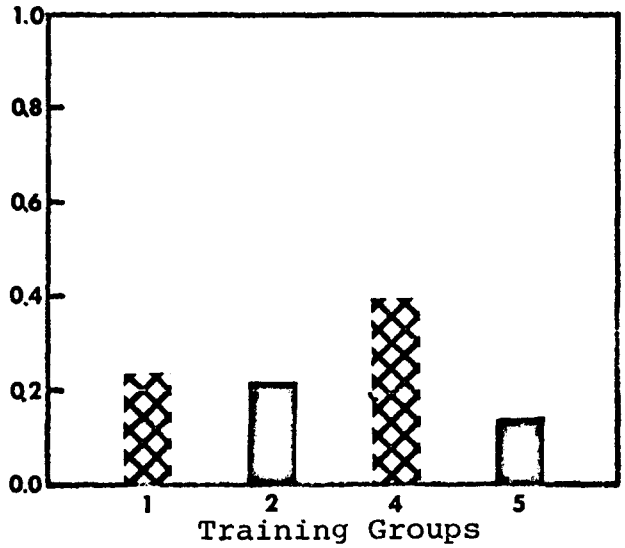
Attributes generated, Group 4--Continued



Manet: Realistic

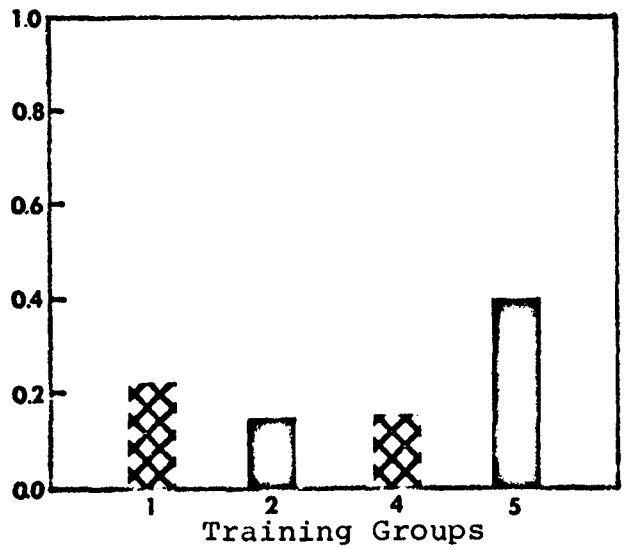


Degas: Hazy, Obscure Background

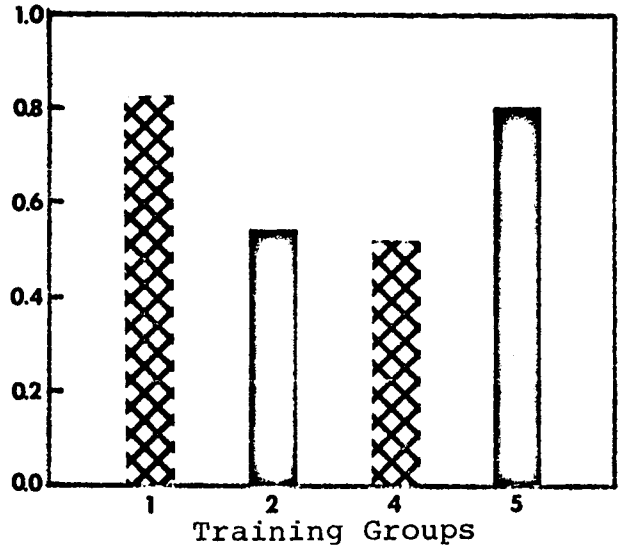


Lautrec: Setting

Attributes generated predominantly by Groups 1 and 5

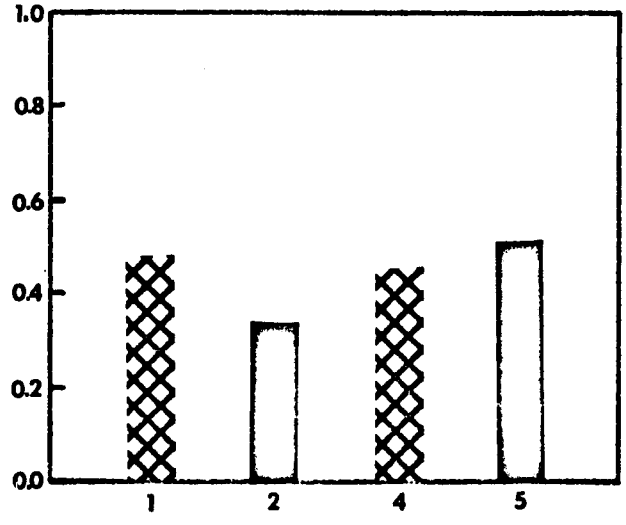


Manet: Contrast



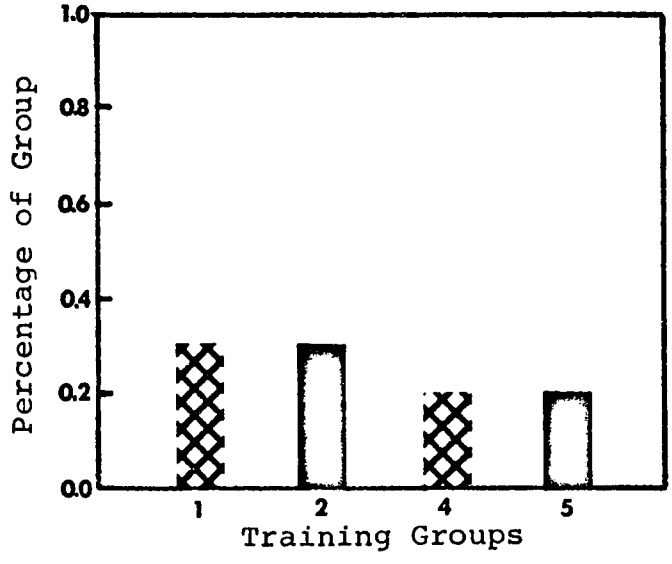
Renoir: Soft Appearance

Attributes reported by all groups with approximately equal frequency

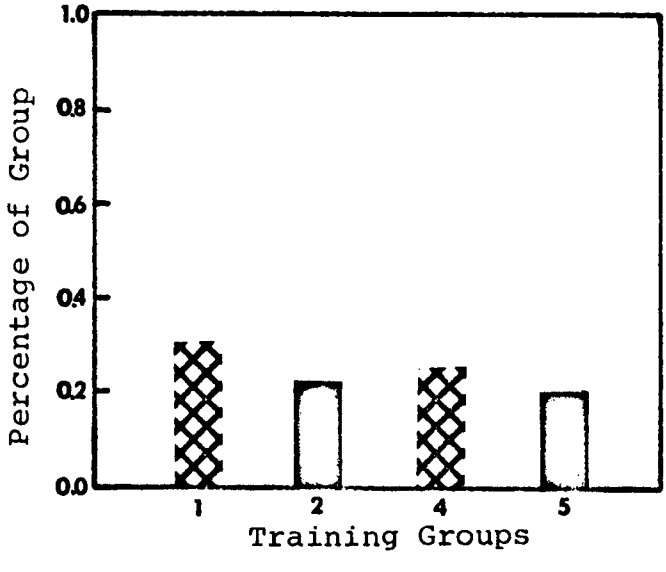


Manet: Clarity

Attributes reported by all groups--Continued



Renoir: Hazy Color



Lautrec: Dark Color

APPENDIX H

SLIDES USED IN THE EXPERIMENT

How the Test Slides were Chosen

Test slides were selected from the collection of the University of Arizona Art Department. All color slides of paintings by Manet, Renoir, Degas, and Lautrec were pulled by the experimenter and viewed simultaneously on a light table. From the total number of slides for each artist, 35 were picked. These were the 35 most typical (stylistically) and/or best known works of each man, in the experimenter's opinion. From this group the experimenter selected ten slides for each artist that were in her opinion the most typical and/or best known, regardless of subject matter.

These 40 slides were placed face down on a light table in random order, so that the labels on the slides were not visible. Two students (one at a time) were asked to sort these slides by putting together in one group all slide slides they believed to have been done by a single artist. These students did not know the artists' names nor how many artists there were. Each student independently made four groups. The students did not participate further in the experiment.

On the basis of this preliminary sorting, it was clear that Lautrec was very easily identified and was almost never mistaken for any of the others. Degas was confused with almost every other artist. He was the only one occasionally to be considered the same as Lautrec, and his work was confused more with Renoir than with either Lautrec or Manet. Renoir seemed to be perceived as equally similar to both Manet and Degas. Renoir and Degas were grouped together more than any other two artists. Manet and Renoir were grouped together more often than Manet and Degas, and Manet and Lautrec were not grouped together at all.

Before the slides were sorted a second time, the attempt was made to manipulate perceived style differences revealed by the first sorting. The object was to make Lautrec seem closer stylistically to the other three artists, especially to Degas; to make Degas seem less like Renoir; and to leave Manet close to Renoir but fairly distinguishable as the target stimulus in the immediate generalization (signal detection) task.

To accomplish this, approximately ten more slides were selected from the original 35 pulled for each artist. These additional slides were judged by the experimenter as being either stylistically similar or dissimilar to the works of other painters. Subject matter was also selectively controlled at this time to make it more constant

across artists, thus reducing its effectiveness as a sorting cue.

Two additional students, one at a time, sorted this new group of 80 slides (approximately 20 per artist). These slides were arranged, as before, on a light table so that their labels were not visible. This time each subject was told to form four groups, but was not told the artists' names nor how many slides should be in each group. These students also did not participate in any other part of the experiment.

The students who sorted slides the second time performed very consistently, grouping many of the same slides together. In general the groups were formed on the basis of style differences, with the result that each group contained several artists. A scatter diagram was constructed to observe the correlation of the two subjects' groupings. This was used as a guide in selecting slides to be used in the experiment.

An additional 20 slides (5 for each artist) from the originally selected 35 were chosen by the experimenter for use in the delayed tests. These additional slides were assigned at random to the generalization-after-delay set (3 per artist) or to the aesthetic-preference set (2 per artist). The considerations already discussed influenced the experimenter in her choice of slides, although not all

slides in this second group were among those sorted by students.

Matrix Number 1

The numbers listed in columns under each artist within the cells (66, 535, 544, 404, etc.) are catalog numbers from The University of Arizona Art Department Slide Library. Each number represents a specific slide of a painting by the artist in whose column it appears.

Judge # 2

Groups

Judge # 1

	1				2				3				4			
	M	R	D	L	M	R	D	L	M	R	D	L	M	R	D	L
1		66	535 544	404	357 340 350	63	510 546	406 409 434	3325		516 517	430		700		413
	Total: 4 slides				Total: 9 slides				Total: 4 slides				Total: 2 slides			
2			522			620 601	534	429 428		716	556 523 521 554	435 398 397 420 390 399 389 391				427
	Total: 1 slide				Total: 5 slides				Total: 13 slides				Total: 1 slide			
3		692 693 703	547 506 507 536		348 359	608 650 705 602 701		412	337	631 606			343 335 332 341	694 699	508	402
	Total: 7 slides				Total: 8 slides				Total: 3 slides				Total: 8 slides			
4	329 339			405	336		532		3345	615			345 3255 3241 355 323	697 691	552 537 555	401
	Total: 3 slides				Total: 2 slides				Total: 2 slides				Total: 11 slides			

M = Manet; R = Renoir; D = Degas; L = Lautrec

Matrix Number 2

Rows and columns of Matrix 1 have been transposed to indicate correlation between judges. Cell numbers are the total number of slides in each cell.

13	5	1	1
4	9	4	2
3	8	7	8
2	2	3	11

Matrix Number 3

This matrix lists the slides used in training and immediate generalization (15 per artist) and indicates which ones are confused with other artists, and with whom. The total indicates the number of slides in each cell. The numbers in parentheses refer to the cell in Matrix 1 from which these slides were taken.

L	D	R	M	
8 (2-3) 1 (2-4) Total: 9	D L 2 1 (1-3) 2 3 (1-2) Total: 8	R L 2 2 (2-2) 1 ? (2-3) Total: 5*		L
	2 (1-1) 1 (2-1) Total: 3	R D 3 4 (3-1) Total: 7	M D 1 1 (4-2) 5 3 (4-4) Total: 10	D
		2 (3-3) 1 (1-4) Total: 3	M R 2 5 (3-2) 1 1 (4-3) Total: 9	R
			4 (3-4) 2 (4-1) Total: 6	M

*The slide paired with the question mark falls in a cell with 8 Lautrecs. This should reduce the total of unconfused Lautrecs somewhat, giving it a weight similar to that of Manet. I am in doubt as to how to represent this. It is the only place in the matrix that a Matrix 1 cell is listed twice.

Pilot Testing

After the test slides were chosen and assigned at random to the various sets to be used in the experiment (training, immediate generalization, retention and delayed generalization, training slide recall, aesthetic preference, and elicited relevant attributes), the training and immediate generalization sets were shown to four students as a pilot test. These subjects participated only in this segment of the experiment.

Four subjects were shown the training slides and given instructions for the active label-plus-rule treatment group. As each slide appeared on the screen subjects were asked to write the name of the artist on an answer sheet, after which the experimenter repeated the correct name and rule. The sequence of slides was repeated four times. Subjects reported the artists' names with 100% accuracy on the third repetition and reported being bored on the fourth repetition

The set of immediate generalization slides was then shown and it appeared that between half and two-thirds of the Manet slides were correctly identified.

Final Order of Slides Used for Training and Immediate Concept Generalization

A. Training

1.	48.3241*	Manet, The Street Singer
2.	44.390	Lautrec, Contesse A. de Toulouse-Lautrec
3.	48.323	Manet, The Balcony
4.	12.510	Degas, At the Milliner's
5.	67.602	Renoir, Woman in a Boat
6.	44.420	Lautrec, Rue des Moulins: The Inspection
7.	48.332	Manet, The Piper
8.	48.348	Manet, Greenhouse
9.	12.506	Degas, Madame Rene Degas
10.	67.615	Renoir, Prt. of Claude Monet
11.	48.336	Manet, Argenteuil
12.	12.516	Degas, Danseuses Saluant
13.	44.434	Lautrec, Woman at her Toilet
14	12.535	Degas, The Milliners
15.	67.601	Renoir, La Grenovillere
16.	67.606	Renoir, Bather Fixing Her Hair
17.	44.406	Lautrec, At the
18.	67.705	Renoir, Girl with a Straw Hat
19.	12.546	Degas, L'Absinthe
20.	44.435	Lautrec, Red-Headed Woman etc.

B. Immediate Generalization

1.	67.631	Renoir, Girl with a Watering Gun
2.	44.389	Lautrec, M. Boileau at the Cafe
3.	67.620	Renoir, La Grenouillere
4.	12.507	Degas, Madame Dietz-Monin
5.	67.693	Renoir, Girl's Head
6.	67.703	Renoir, The Bathers
7.	44.399	Lautrec, Woman at her Toilet
8.	12.547	Degas, Woman Ironing
9.	48.329	Manet, Olympia
10.	44.430	Lautrec, The Modiste
11.	48.343	Manet, Bar at the Folies-Bergere
12.	12.522	Degas, Two Laundresses
13.	67.650	Renoir, Moulin de la Galette
14.	12.532	Degas, Woman w/ Chrysanthemums
15.	48.339	Manet, Nana
16.	67.608	Renoir, Sailboats at Argenteuil
17.	12.552	Degas, Mademoiselle Malo

*The number preceding the title of the slide is a catalog number used by the Art Department Slide Library, The University of Arizona.

18.	67.716	Renoir, Nude in the Sunlight
19.	67.692	Renoir, Woman with a Cat
20.	48.3255	Manet, Berthe Morisot
21.	44.398	Lautrec, Private Room at the Rat Mort
22.	12.536	Degas, The Millinery Shop
23.	67.700	Renoir, Mme. Charpentier and
24.	12.544	Degas, Cafe Concert: "Song of the Dog"
25.	44.428	Lautrec, Model Resting
26.	48.335	Manet, Gare Saint-Lazare (mother, daughter looking through fence)
27.	48.341	Manet, At the Cafe
28.	48.359	Manet, In a Boat
29.	67.701	Renoir, Lunching of the Boating Party
30.	12.517	Degas, Four Dancers
31.	12.537	Degas, Cafe Singer Wearing A Glove
32.	44.397	Lautrec, Nude in Front of a Mirror
33.	12.555	Degas, Horse Races at Longchamp
34.	44.391	Lautrec, Crouching Nude
35.	44.409	Lautrec, Last Crumbs
36.	44.429	Lautrec, L'Anglaise du "star" du Havre
37.	44.427	Lautrec, Paul le Clerq
38.	48.345	Manet, Mme. Michel-Levy
39.	48.355	Manet, Non-Com Officer Holding Rifle
40.	48.3345	Manet, Portrait of Zacharie Astruc

Final Order of Slides Used for Posttests

A. Training Slide Recall

1.	12.516	Degas, Danseuses Saluant
2.	12.535	Degas, The Milliners
3.	44.390	Lautrec, Contesse A. de Toulouse-Lautrec
4.	67.615	Renoir, Prt. of Claude Monet
5.	48.3241	Manet, The Street Singer
6.	67.602	Renoir, Woman in a Boat
7.	44.420	Lautrec
8.	48.323	Manet, The Balcony
9.	48.336	Manet, Argenteuil
10.	12.510	Degas, At the Milliner's
11.	44.435	Lautrec, Red-Headed Woman etc.
12.	67.606	Renoir, Bather Fixing Her Hair

B. Retention and Delayed Generalization

1.	67.631	Renoir, Girl with a Watering Can
2.	12.517	Degas, Four Dancers
3.	44.395	Lautrec, Maxime Dethomas at the Opera Ball*
4.	44.397	Lautrec, Nude in Front of a Mirror
5.	44.409	Lautrec, Last Crumbs
6.	67.700	Renoir, Mme. Charpentier and her Children
7.	12.507	Degas, Madame Dietz-Monin
8.	48.3345	Manet, Portrait of Zacharie Astruc
9.	44.399	Lautrec, Woman at her Toilet
10.	67.701	Renoir, Lunching of the Boating Party
11.	48.345	Manet, Mme. Michel-Levy
12.	48.359	Manet, In a Boat
13.	12.526	Degas, After the Bath*
14.	44.386	Lautrec, Jane Avril Leaving the Mouin Rouge*
15.	12.503	Degas, Mme. Camus*
16.	44.413	Lautrec, At the Moulin Rouge*
17.	67.603	Renoir, La Nymphe a la Source*
18.	67.605	Renoir, Portrait of Misia Sert*
19.	67.612	Renoir, The Swing*
20.	48.334	Manet, Breakfast in the Studio*
21.	48.331	Manet, The Dead Toreador*
22.	48.3275	Manet, The Music Lesson*
23.	12.520	Degas, The Interior (The Rape)*
24.	12.532	Degas, Woman With Chrysanthemums

C. Aesthetic Preference

1.	12.523	Degas, The Tub*
2.	67.601	Renoir, La Grenovillere
3.	12.546	Degas, L'Absinthe

4. 48.349 Manet, Execution of Maximilian*
5. 48.348 Manet, Greenhouse
6. 12.555 Degas, Horse Races at Longchamp
7. 67.600 Renoir, Breakfast in the Garden*
8. 44.434 Lautrec, Woman at her Toilet
9. 12.506 Degas, Mme. Rene Degas
10. 48.355 Manet, Non-Com Officer Holding his Rifle
11. 48.330 Manet, Dejeuner sur l'Herbe*
12. 48.343 Manet, Bar at the Folies-Bergere
13. 44.391 Lautrec, Crouching Nude
14. 48.332 Manet, The Piper
15. 44.406 Lautrec, At the Moulin de la Galette
16. 67.705 Renoir, Girl with a Straw Hat
17. 44.393 Lautrec, Friends*
18. 67.716 Renoir, Nude in the Sunlight
19. 67.630 Renoir, Her First Outing*
20. 12.544 Degas, Cafe Concert: Song of the Dog
21. 44.427 Lautrec, Paul le Clerq
22. 12.501 Degas, The Bellelli Family*
23. 67.703 Renoir, The Bathers
24. 44.408 Lautrec, At the Moulin Rouge: The Dance*

D. Relevant Attributes

1. 48.329 Manet, Olympia
2. 67.692 Renoir, Woman with a Cat
3. 12.552 Degas, Mademoiselle Malo
4. 44.389 Lautrec, M. Blileau at the Cafe

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*New slides.

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