HEIGHTENING INTEGRATED COLOR SENSITIVITY: AN EXPERIMENTAL STUDY

by

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B.A., Simon Fraser University, 1972

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS (EDUCATION)

in the Department

of

Behavioural Science Foundations

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SIMON FRASER UNIVERSITY

August 1973

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Title of Thesis: Heightening Integrated Color Sensitivity:
An Experimental Study

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Title of Thesis/Dissertation:

Heightening Integrated Color Sensitivity:An Experimental Study."

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August 15th. 1973.

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ABSTRACT

The primary purpose of the present study was to develop and explore the concept of integrated color sensitivity. This was initially taken to mean the extent to which an individual's physiological color sensitivity is integrated, i.e., into his conceptual framework or worldview. Several steps were involved in this investigation.

First, four dimensions of the concept were operationally defined. These dimensions were (1) individuation, meaning the extent to which objects, persons and events were discriminated between by means of color; (2) personal color perception, which indicated how much the individual's color perception was idiosyncratic rather than culturally oriented; (3) actualized color perception, which was an indication of the individual's openness or actualization when faced with color perception tasks; and (4) transactional color perception, which meant the extent to which the individual was affected by a color perception situation. The explication of the concept of integrated color sensitivity in terms of these four dimensions involved the examination of ordinary life situations as well as more abstract considerations.

Secondly, a condensed color sensitivity training course--involving activities such as meditation with color as the focus,

color perception 'games' using various colored papers, film and slide viewing, and discussion--was patterned on the methods and casual findings of a number of pilot studies conducted by the writer. This short course was subsequently used to test the general thesis that integrated color sensitivity can be heightened.

Thirdly, a color discrimination test--the Farnsworth-Munsell 100-Hue Test--was administered in order to test to what extent integrated color sensitivity was a function of physiological color vision ability.

Fourthly, a test was designed to measure integrated color sensitivity, both before and after the short sensitivity training course, on the four dimensions mentioned. This test was made up of four black and white pictures which were to be colored, and two questions involving the subject's perception of the coloring task.

The testing and training involved a total of 26 subjects, and the entire experiment--consisting of pre-training testing, color sensitivity training, and post-training testing--took place over a three day period. One group of fifteen subjects participated in all three stages of the experiment while another 11 subjects only participated in the pre and post-training testing.

The results were unexpected and highly pleasing considering

the novelty of the concept under investigation and the untried nature of the methods used in assessing performance. A major aim of the training was to heighten performances on the four dimensions of integrated color sensitivity. The hypotheses dealing with actualized and transactional color perception were confirmed, the one dealing with individuation was partially confirmed, while the hypothesis dealing with personal color perception was rejected. It was furthermore found that an individual's physiological color vision profile does not seem to give any indication of how he will perform on the integrated color sensitivity test.

It was concluded that the investigation had amply justified the postulation of the concept of integrated color sensitivity, that it had contributed much information about the concept, and that further studies in this direction should result in valuable insights into man's dealings with his color environment.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

This thesis attempts to investigate, on as wide a front as possible within the present format, one particular aspect of the interaction between man and his color environment. The particular aspect is cast in terms of the individual's ability to increase his sensitivity to color stimuli, and the particular ability in question is termed 'integrated color sensitivity'.

Whereas a full account of the concept of integrated color sensitivity is presented in chapter II, it can briefly be described here as the emphasis the individual places on color rather than on other dimensions of reality.

It is generally recognized that some individuals are better attuned to or have a greater affinity to colors than others. In choice situations, these individuals will focus their attention more readily on the dimension of color than on other dimensions making up the visual, or indeed the total experiential situation. They somehow feel more comfortable dealing with the environment in terms of color than in other terms, and they seem to be more aware of their color surroundings than other individuals.

Artists, for instance, are often spoken of in terms of

their color sense, being called 'colorists' if the main emphasis in their work is on color. Other pictorial artists who perhaps are less attuned to color may place a greater emphasis on form or line or any of the other so-called elements of design. Thus, one form of painting is termed 'chairoscuro' since it mainly deals with the element of value (i.e., lights and darks), and the major difference in emphasis between the chairoscuro and the colorist painter is what here is called integrated color sensitivity.

Non-artists are also often spoken of in terms of their facility with color. We say, for instance, that a person who pays special attention to color in the selection of, say, household or personal articles is 'color conscious', and we are all familiar with the person who 'would never be caught dead' with this or that color dress or shirt on. It is often said that women in our society are more color conscious than men, that because women often select colors for the home and in many cases attentively follow the changing fashion trends in color (a preoccupation which men, fortunately, have been getting involved in lately too), they must be more sensitive to color. Although it is true that a greater percentage of males are color deficient or color blind than females (Pickford, 1951), it need not be true that the present type of integrated color sensitivity necessarily follows the same pattern. Furthermore, a behavior which indi-

cates an interest in color along the lines described, need also not indicate a high level of integrated color sensitivity. There is no reason to believe that to express oneself in bright and attractive (i.e., attention-getting) colors is indicative of a more highly developed integrated color sensitivity than to suppose that to express oneself in dull colors (e.g., in dress, etc.) indicates an insensitivity to colors. In fact, the latter may be as much an expression of awareness of colors as the former.

Precisely what the difference is between a color conscious person and an artist of the colorist inclination is difficult to determine. It may be one of degree of practical experience with colors as Gardner (1959) suggests: "The exploration of color... can only be experienced, or really understood, by intense practice and experimentation." (p. 13) Gardner, however, does not specify what she means by practice and experimentation. Presumably, tasks such as mixing colors and applying them to paintings are some of the means she has in mind. But it is certainly the case that non-artists also experiment in this way, with their clothing, their home decorating, and so on. The degree of understanding (or sensitivity) therefore does not seem to be related to any one particular method of encountering color.

There is in addition more to the 'exploration of color' than she indicates. The process she describes may lead to what

might be called color sensitivity if by that one simply means that the individual has acquired an ability to pick the 'right' or appropriate color for a particular situation. The parallel expression to this in music is 'musicianship'. However, the concept presently under investigation goes much beyond that insofar as it involves color sensitivity which is integrated. That is, integrated color sensitivity refers to the extent to which the individual's color perception of the world has become a part of himself, is a cogent expression of his self and, to some extent, of whether he is aware of this coherence, or lack of it, between his self-expression and his color perception.

The present sense of 'sensitivity' differs in some respects from that employed in the contemporary context of 'sensitivity training' and 'sensory awakening training', for example. The former refers to a concept which, in the present writer's opinion, has existed for a long time--although perhaps not very explicitly or concisely stated--and which seemingly has not so far been subjected to any sort of systematic investigation. The latter concept is related to a more recent development in the field of human interaction, typified in terms of its goals as "a social vehicle for helping individuals increase their effectiveness in self-fulfillment and in relating to others." (Bugental and Tannenbaum, 1963, p. 85) The present endeavor is much less ambitious in the sense that only a small aspect

of a person's behavior is being investigated, but perhaps more ambitious in the sense that a highly specific part of the individual's behavior is being developed, and in the sense that a high degree of precision is embodied in the specification of the stimulus responsible for that particular aspect of personal growth.

The concept of integrated color sensitivity is not covered directly in the literature. 'Color sensitivity' is extensively dealt with by experimental psychology (an article by Norman and Scott, 1952, gives an excellent overview of the field as seen from different viewpoints) and, from the opposite direction as it were, the closest one can get to a coverage of how personal growth results from particular stimuli or 'facilitators' (which as was mentioned remain largely unspecified), is exemplified by Vick and Rhyne's (1967) studies into psychological growth and the use of art materials. But no studies so far appear to have focussed on the personal growth phenomenon in terms of integration of particular, specifiable physical stimuli.

As might be expected in an undertaking of this nature, many problems emerge as the investigation progresses. The solving, or at least the discussion, of these problems, it is felt, adds a degree of depth to the investigation. At the same time it is recognized that some basic problems still remain to be sorted out. The particularity of these problems is dis-

cussed briefly in the concluding part of the thesis. In the meantime, confidence to proceed with the present inquiry is drawn from the writer's general curiosity about these matters as well as from Maslow's (1966) convictions about investigating the so-called 'un-investigable':

> I got into real trouble only when I started asking new questions for the researcher, questions which I couldn't handle well, questions about imprecise, undefined, unmanageable problems. I discovered then that many scientists disdain what they cannot cope with, what they cannot do well. I remember counterattacking in my irritation with an aphorism I coined for the occasion: "What isn't worth doing, isn't worth doing well." Now I think I could add: "What needs doing, is worth doing even though not very well." (p. 14)

* * *

It is presently hypothesized that certain group training techniques, which are described in detail in chapter V, can facilitate the heightening of an individual's integrated color sensitivity.

To investigate this, the following strategy has been adopted:

1. An operational concept of integrated color sensitivity is explicated (cf. chapter II).
2. A number of pilot projects embodying a variety of training techniques have been conducted. The details of these

are described in chapter III.

3. Based on the informal findings of these pilot projects, a specific set of techniques are used in a one session integrated color sensitivity training course.
4. A two part test has been adopted for the assessment of the extent of the individual's integrated color sensitivity (cf. chapter V). The first part consists of a standard psychophysical color vision test, and the second of a test especially designed for the present purpose. Both parts of the test are administered before and after the training session.

CHAPTER II

INTEGRATED COLOR SENSITIVITY

The procedure employed in the explication of integrated color sensitivity is based, first, on the premise that the individual has certain physiological capacities for responding to color. This particular type of sensitivity is generally analyzed in psychophysical terms, and it is dealt with here in section II.

Secondly, it is assumed that not all individuals utilize their physiological color sensitivity in the same way or to the same extent. It is assumed that responding to color, at least in the case of humans, is more than an unknowing response, and that it is possible to characterize the degree and quality of this aware activity. Thus, the concept presently under scrutiny is termed integrated color sensitivity since the focus of its investigation is on the extent to which the individual's physiological color sensitivity is 'integrated', i.e., on the extent to which it has become an integral part of that individual's behavior, worldview, conceptual framework, etc.

The internal structure of integrated color sensitivity as well as the relationship between it and other types of color sensitivity is examined in sections I and II respectively.

I INTRA-STRUCTURE

Introduction

There are four distinct dimensions of integrated color sensitivity which, it is argued, minimally must be included in an analysis of the concept. These are derivatives of two general aspects of the concept which seem to characterize its essential attributes. The two general aspects--'color as priority' and 'creative aspect of color perception'--will be discussed first, and then the explication of the four dimensions of the concept will follow. Finally, a brief summary will pull together the operational concept of integrated color sensitivity in the form of a set of definitions.

The fact that integrated color sensitivity here is analyzed in terms of four dimensions is arbitrary to the extent that a number of them might in some instances overlap, and in the sense that other researchers might wish to add different--and to them perhaps more important--facets of the concept. It is however a well known fact that concepts developed in this manner fully explicate, although they may not exhaust, what they originally set out to characterize, i.e., the pre-analytic concept. Torrance's (1966) operational concept of creativity, for instance, is a good example of a concept of this nature. One may raise any number of objections to his interpretation of this concept, yet by definition his explicated concept characterizes fully the pre-

analytic concept he sets out to explicate. Inadequacies of the explicated concept (e.g., that it perhaps is not realistic enough) cannot be sought in the lack of characterization of the original concept but rather in the lack of correspondence between individual parts (i.e., in inconsistencies) within the two levels of the concept.

If these inconsistencies persist it may simply mean that the explicated concept is not definitive. Presumably here even the present investigation--including the series of experiments reported on later--will contribute information which will make a revision of the concept desirable. However, this is as it should be with an original explication of a concept. Only through a deliberate trial and error method can it be refined into a concept which strikes the happy balance of being analytic enough to be of practical use in further research and synthetic enough to encompass as much as possible of its everyday meaning.

By 'analytic enough to be of practical use' is here specifically meant that the developed concept should be clear and distinct to such an extent that its four dimensions can be specifically and individually dealt with in the training techniques and evaluation instruments described later (cf. chapters III and V respectively).

Figure 1 gives an indication of the stages of analysis leading to the construction of the four dimensions of inte-

COLOR AS PRIORITY

The extent to which color plays a major role in the individual's activity of conceptualizing and expressing his view of the world.

CREATIVE ASPECT OF COLOR PERCEPTION

The extent to which the individual creates his personal view of the world through color.

1. Individuating through color
2. Personal color perception
3. Actualized color perception
4. Transactional color perception

FIGURE 1 Stages of explication of integrated color sensitivity showing two general aspects of the concept and the four derivative dimensions.

grated color sensitivity.

Color as priority

In a study dealing with sensitivity to color, the notion of color--as the particular stimulus in question--must of necessity occupy a position of priority as compared to other stimuli. This is not only to say that the major emphasis must be placed upon color in general, but that color in some ways must be that stimulus which predominantly elicits the specific responses which are here collectively termed 'integrated'.

As mentioned in chapter I, some painters have placed a greater emphasis on color than on other elements of design such as line, tone, texture, volume, and so on. The priority of color as a means of expression in these painters' work seems evident, and they thus become good examples of individuals who may possess some higher than usual measure of integrated color sensitivity. One must assume that color is the one visual dimension which to these individuals makes the world 'what it really is', i.e., that it occupies a position of priority in their conceptualization of the world as a result of the evidence of color being a priority in their work.

As an historic example of a growing awareness among painters of color as a priority element of design one might take a brief look at French painting during the last century. There is a

gradual development from David's and Ingres' rendering of form in terms of lights and darks, almost resembling bas-relief according to Gardner (1959), through Delacroix's rejection of grays, to the colorful paintings of the Impressionists in the latter part of the century. Among the Impressionists, Seurat's divisionist technique is based directly on psychological color theories of the earlier part of the century (Leymarie and Skira, 1955), Cēzanne "achieved convincing solidity and structure by the control of color alone" (Gardner, 1959, p. 669) and Monet, who is supposed to have lost the ability to clearly see form and outlines of objects toward the end of his life, gave himself over completely to the celebration of color in his water lily paintings and 'views' of cathedrals and haystacks. At the end of this development, a painter like Bonnard is characterized by his "dazzling palette which transformed everything he saw into a symphony of color" (Leymarie and Skira, 1955, p. 122).

Even if color is not part of an artistic or creative enterprise in the ordinary sense of those terms--that is, as that looking-glass through which the creator looks for the 'invisible' (Merleau-Ponti, 1961)--it can still figure as a priority in an individual's interpretation of the world. Given a situation in which a choice between things of different color (e.g., hue) must be made, some will choose mainly because of the color difference, while others will choose on the basis of some other

factor or a combination of these.

There may, of course, be practical considerations which in some cases obscure the priority determining the choice. However, while one can argue that necessity may in some way shape one's priorities, it is hardly possible to defend the position that practical considerations always determine present priorities. What priorities one has must be distinguished from what priorities one is forced to display due to circumstances beyond one's control. The point here is that it seems necessary to qualify the notion of color priority by adding that other priorities must be equally possible.

Perhaps because of the fact that practical considerations may obscure color as a priority in a choice situation, and perhaps because of other factors such as temporary, excessive color stimulation (which may make the individual less interested in color for the time being), one can speculate about what might be called the transitory nature of color priority, and indeed of integrated color sensitivity. In the experiments described in chapter V, no particular attempt is made to create an experimental environment which specifically makes the subject aware that responses of the priority type to color is the prime consideration. At the same time, no attempt is made to conceal the fact that color is involved.

For the present purpose it is sufficient to note that

color priority may be subject to fluctuations, and that a detailed study of this particular phenomenon will have to establish just to what extent these fluctuations influence the statistical results of small population responses. In this respect, the present study does not differ from other studies involving voluntary responses.

Creative aspect of color perception

A special definition of 'creativity' is employed in the present study. It involves (1) the purely subjective activity of perceiving the color world in general, and (2) the notion that this activity, as a result of (1), may reflect a departure from the way the color environment is conceived of as a matter of convention by the society of which the individual is a member. The first part of the definition is dealt with below, whereas the second part is discussed later under the heading of 'personal color perception'.

Color is usually seen as one of a number of dimensions of the real world. Other visual dimensions competing with or, more properly, complementing color in this respect might be spatiality, movement, visual texture, etc. And among all the possible dimensions in terms of which one usually deals with the world, color (as part of the visual dimension) can be said to compete with or complement any number of other modes of perception

covering other sense dimensions such as sounds and smells.

To some philosophers--notably some Existentialist philosophers--these dimensions are not only dimensions imposed on the real world out of convenience, but they are what in fact makes the world real in the first place. If this view is adopted, color becomes one of those 'yardsticks' by means of which individuals create their world.

This yardstick, although among the indices of 'what is out there', by no means becomes an absolute measure of reality. Poincare (1952), in regard to the three dimensions of space (and one must assume that color as a category would be subject to the same type of approach), points to a number of reasons why this is really quite an arbitrary paradigm: that the three dimensions provide us with one convenient way of dealing with practical problems but that any number of other systems--presumably specifying any number of space dimensions--conceivably would do as well. The age old argument for the a priori status of Euclidian geometry is a case in point. Not until spherical geometry was invented in the last century did it become generally acknowledged that Euclid's interpretation was just that: one interpretation among any number of possible ones. Finally Merleau-Ponti (1961) writes: "It is no more possible to make a restrictive inventory of the visible than it is to catalogue the possible usages of a language or even its

vocabulary and devices." (p. 165) If 'color', being an essential part of the visible, is substituted for 'the visible' in this quotation, it becomes clearer how the colored world cannot be thought of as absolute, static and open to inventory-taking. This view however introduces particular problems of its own, one of which is discussed in detail in section II of this chapter.

Realizing this non-finite nature of the color world, it becomes evident how one is justified in applying the creative paradigm to color perception. This is not to say that other paradigms do not have their practical uses. One may, for instance, with equal justification hold that colors consist of electromagnetic waves radiating from objects, that these waves by definition are 'colorless' and that 'color' in its everyday sense does not occur until a human observer is introduced. Or, one may think of objects existing in nature in a three dimensional form, and that their colors are separate attributes--painted onto the objects, as it were--of the objects. But again, it makes sense to say that even this view cannot be sustained unless the human observer is somehow part of the perception situation.

The present paradigm of creative color perception takes in both the notion that the color world is not subject to a finite inventory statement but that, by definition, any sort of extended

coverage of 'what is out there' is possible, and that the base-line for whatever paradigm is used necessarily must be fixed in relation to the individual's color perception if one is concerned with sensitivity of the individual.

If these, roughly, are the facts of color perception according to one line of thought, it is possible now to begin speaking of the individual's knowledge of this process, of his awareness of, or sensitivity to, this rather momentous, creative feat performed during the everyday task of color perception. And in addition to the awareness of this process--in fact as a result of it--one can begin to speak about the individual's effectiveness in creating his color world, not of course as measured against any one particular, defined criterion, but in terms of how his constructs in general are relevant to and fit in with his particular problems at the time. In other words, it becomes a question of the creative efficiency with which the individual makes use of color as a sensory input in situations where (other things being equal) the successful solution of a problem depends on color being the major constituent of the perceived situation. The notions of color priority and creativity of color perception are thus to that extent inseparable.

1. Individuating through color

As one aspect of subjective or creative color perception,

the extent to which it is possible for an individual to 'individuate' between objects, persons and events through color is discussed here. The term 'individuate' is used rather than 'discriminate' or 'distinguish' since, as will be mentioned shortly, more than just telling 'items' apart is involved. To individuate, here, also includes the notion that individual, existing things (i.e., objects, events, etc.) are created through the act of individuating.

Leibniz's (1951) well known theory of the 'identity of indiscernibles' holds that if all the perceptible dimensions of a number of objects--including that of spatial location--were indiscernible, there would be no way of individuating them, or even of perceiving them as objects. Consider the often used example of the picket fence. If all the pickets were in the same spatial location (a thought experiment which one's mind finds somewhat difficult to perform but which is nevertheless not conceptually impossible), and have the same physical appearance, there would be no way of telling one from the other, and thus of individuating them. But if the pickets each were of a different color it would be a simple matter to tell one picket from its neighbor. Color is therefore clearly one of those dimensions which enable one to individuate between objects. The same would furthermore hold for individuating between persons and events. Persons can be individuated through the color of the

clothes they wear, their skin color, their hair color, and so on, and events can be individuated through color in terms for instance of mood. An example of this type of individuation might be the contrast between the gray colors of a rainy and (to some) depressing day and the exuberant colors of a happy excursion to the seaside.

Besides making one object different from another in a 'mechanical' sense, color can be said to make an object 'what it really is'. Merleau-Ponti (1961) speaks of how Cēzanne 'interrogates', through the analysis of light, lighting, shadows, color, his beloved Mont-Sainte-Victoire: "The painter's gaze asks them what they do to suddenly cause something to be and to be this thing...". (p. 166) So, the two aspects seem to be inseparable: 'to be' and 'to be this thing'. And by focussing on this particular thing, rather than on it as an instance of a species, Cēzanne reveals his existential preoccupation, echoing the view that there somehow are 'bad faith' connotations involved when an object is regarded merely as an object of a particular kind rather than as an object possessing its own uniqueness or 'being'.

2. Personal color perception

As a child develops, he learns about the world through his own exploration of it as well as through the teachings of others

about it. As Schachtel (1959) writes:

> While part of this exploration takes place in the spontaneous and immediate encounter with the objects, an important part consists in the increasing acquaintance with their meaning in the culture. Such learning on the one hand enriches the object world of the growing child to a degree which could never be reached by an isolated individual. On the other hand, it also increasingly supplants the child's original approach to the objects and, especially in our time, entails the danger of closing his openness toward the world and of reducing all experience to the perception of such performed clichés and "angles" as make up the world of "reality" seen by the family, peer group, and society in which he grows up. (p. 137)

Although the cultural 'world view' therefore, according to Schachtel, to some extent hinders the perceptual development of the child, it is no doubt also the case that it--apart from 'enriching' the object world--is a necessary condition for any perceptual development at all. The compromise position which utilizes the cultural while making possible the individual development is well expressed by Dewey (1957):

> ... a truly humane education consists in an intelligent direction of native activities in the light of the possibilities and necessities of the social situation. (p. 92)

And again, the reason why one particular paradigm (or world view) is adopted seems to rest on the present social possibilities and necessities, as Poincare (cf. above) notes, rather than on any claim to a priori status.

Now, it seems that the individual can assume two views of the world: one which overlaps almost completely that of the

society in which he lives, and which is based on and is the result of shared cultural experiences; the other which is unique to the individual--although it initially may have been 'activated' by cultural teaching--and which furthermore does not derive its motive power from the 'possibilities and necessities of the social situation'. Much controversy surrounds this issue, and the truth may lie somewhere in between the two extreme views. Dewey (1934), for instance, insists that a work of art is not only the outcome of an individual's imagination, but the individual's imaginative workings on shared physical existences. However, this statement does not seem to touch the individual's perceptual development except to the extent that Dewey claims that the basis for it is in the shared experience, whereas others claim that the impetus for creativity--which, as mentioned previously, is here another word for non-cultural or extra-cultural perceptual ability--originates in the individual's unique, perhaps by definition or other inherent limitation, unsharable, experiences. When Merleau-Ponti (1961) speaks of the artist as giving "visible existence to what profane vision believes to be invisible", (p. 166) he is in fact saying that an individual--an artist--has had visual or perceptual experiences which no one else has had, and that his 'trade' then is to communicate his findings to others so that <u>his</u> unique perceptions may become part of the shared experience.

It is of course often the case that an artist seems to have moved so far from our shared experience that we do not understand what he is trying to say. In the theatre, for instance, one is familiar with a variety of stereotypes, that is, characters which typically express those one meets in everyday life. At times, however, a playwright's characters become idiosyncratic to such an extent that one no longer finds them plausible or realistic. They have ceased to have direct counterparts in the shared experience. According to Dewey, this sort of situation is simply not possible since whatever the artist can imagine must have as its origin his experience, and his experience is but a part of the total social experience. Excluding the possibility that his work has been arrived at in an arbitrary fashion, or that extra-cultural factors are the source of his inspiration, one may well wonder about what has occurred. One answer may be suggested by the fact that while the public often ridicules and scorns so-called modern art as it did when the Impressionists for instance first began exhibiting their works in 1874 (Leymarie and Skira, 1955, pp. 25-26), they really understand it too well. This is the reasoning of the Existentialist commentator Barrett (1958). The present writer's answer would rather be in terms of a reaction to this first answer: that the artist has somehow managed to increase his experiential basis, that he has been 'tinkering' with reality, that new conjunctions of the (public)

language (i.e., in the case of the painter: color, line, etc.) have enlarged his experiential repertoire, that his perceptions of the world have changed correspondingly and that, as a result, he may be said to be more sensitive in his particular area of interest than those around him. One's response to Barrett would therefore be that society is not likely to understand the artist initially, but that after sharing experiences with him through the communicative power of his art, an understanding should emerge.

The artist is in a sense playing a 'category-game': categories are idealized, tested and broken down again, but always in reference to an experiential basis.

Integrated color sensitivity also includes a measure of awareness of this difference between constituting the world through color as others see it, and the way the individual sees it. This may be expressed differently by saying that it involves an awareness of the individual's autonomy of choice: that there are other ways of 'coloring' the world, apart from the way one's culture does it. Although it is true that an individual can be tinkering with his color world without really being aware of the dichotomy between the personal and the cultural, the notion of awareness is made a condition of this dimension of integrated color sensitivity since the act of tinkering must be of a special kind, as will be seen from the discussion of actualized

color perception below.

3. Actualized color perception

While integrated color sensitivity so far has been dealt with in terms implying a certain active state of the individual, there is another sense in which this type of sensitivity essentially is passive.

This stance of passivity is mentioned by Maslow (1966) who calls it the 'Taoistic' approach, and it is characterized by "being able to keep your hands off and your mouth shut, to be patient, to suspend action and be receptive and passive. It stresses careful observation of a noninterfering sort." (p. 96) It is in sharp contrast with what later will be termed 'learned color sensitivity' (cf. section II), in that its prime purpose is not utilitarian.

And Schachtel (1959) speaks of this approach, not only from the point of view of what we may learn about the world, but with the enhancement of the individual's creative faculties in mind:

> Of the different aspects of allocentric perception the openness in turning toward the object is the most basic and important one; the fullest interest in an object is possible only if the person opens himself fully toward as many object aspects as possible, that is, optimally toward the totallity of the object. (pp. 140-41)

Although the full impact of this type of creativity relies on a

wholistic view of the world, one can perhaps with equal justification say that even a wholistic view of a smaller part of the whole--in this case using the dimension of color as the total dimension--will figure prominently in the description of Schachtel's healthy personality. In the present context, then, integrated color sensitivity would to some extent involve the attitude of openness toward the coloration which the individual's mind imposes on the colorless physical world.

A more systematic model is offered by Shostrom (1967). He divides individuals into actualizors and manipulators and, apart from other dichotomized personality characteristics which are not of relevance here, he sharply distinguishes between awareness and unawareness:

Actualizors	Manipulators
Awareness (Responsiveness, Aliveness, Interest). The actualizor fully looks and listens to himself and others. He is fully aware of nature, art, music, and the other real dimensions of living.	Unawareness (Deadness, Boredom). The manipulator is unaware of the really important concerns of living. He has "Tunnel Vision." He sees only what he wishes to see and hears only what he wishes to hear. (p. 24)

The qualities by means of which the present writer is attempting to describe integrated color sensitivity, thus, fit well with Shostrom's model. And in particular, the term 'actualizor' is well chosen since it reflects both the active and pass-

ive nature of color perception as presented here.

The following Cēzanne quote from Dorival (1948) reflects at least two of this painter's intuitive insights relating to the present topic:

> There is a logic of colour; the painter owes obedience to this alone, never to the logic of mind.... He must always follow the logic of his eyes. If he feels accurately, he will think accurately. Painting is primarily a matter of optics. The matter of our art lies there, in what our eyes are thinking. Nature always finds a way to say what she means when we respect her. (p. 144)

First, the logic of color is contrasted with the logic of mind. This relates to the discussion earlier where personal versus cultural views of the world were dealt with. Here Cēzanne makes it plain that the logic of color is something to be found in the inter-relationship or interaction between painter and nature, and not something to be straīt-jacketed into a philosophical model based on the workings of the cognitive faculties. (That the 'logic' of mind of course in due time will have to take account also of his 'logic of color' need not detract from the point he is making.) What Cēzanne furthermore, perhaps unwittingly, is lamenting is the fact that logics of mind usually are verbally based and culturally oriented. This tendency of man to deal with everything in the world in verbal terms is pointed out by Huxley (1969) when he advocates his well-known education on the 'non-verbal' level. His complaint consists in

the fact that even when educators attempt to train children in essentially 'non-verbal' humanities, they do it on a verbal level, based on a verbal framework of mind. And, according to Huxley, this procedure is a logical absurdity.

Secondly, Cēzanne's other insight concerns what he calls respect for nature. 'Nature always finds a way to say what she means when we respect her', he says. And this is precisely the point being made here: that prior categorization--be it based on a personal or a cultural view--only hinders further perceptual development of the individual.

Thus, integrated color sensitivity seen from the present viewpoint of actualizor/manipulator might be translated into an inclination toward openness to the logic of color, that is, toward the power of color to indicate or 'create' facts about the world such as inter-relationships, continuance, growth, change, interference, and so on.

4. Transactional color perception

As was described earlier, the act of color perception is one of creation: the individual creates, as it were, his own colored world. At the same time, while this creating is taking place, the mental categories which form the basis for further visual explorations are established in the viewer. Thus, the relationship between the seer and the seen is really one of 'transaction': both

the object and the subject are equally involved in and affected by the act of perception. Logically, it cannot be a process in which only one of the 'participants' are affected.

At this point an interesting problem occurs. Dewey, although the champion spokesman for the transactional approach, would disagree with the present division of integrated color sensitivity dimensions into passivity and activity. According to him, a paradigm advocating such a dichotomy would merely reflect an analytic distinction and not an existential one. And this view would clearly also be taken by Piaget (1958), committed as he is to the cognitive development theory based on the concepts of accommodation and assimilation. However, since the present investigation is largely oriented toward what has been called the Humanistic viewpoint--and writers in this genre clearly see evidence of an existential distinction--the present separation will be adhered to. At any rate, should difficulties occur in maintaining this distinction, they should show up in the experiments reported on later.

Many people have reported to the writer how this affinity between, say, visual nature and themselves has been felt, particularly during open and passive observation. And Merleau-Ponti (1961) mentions the same sort of situation when he quotes Paul Klee: "In a forest, I have felt many times over that it was not I who looked at the forest. Some days I felt that the trees

were looking at me, were speaking to me...". (p. 167)

If this type of transactional relationship between perceiver and perceived can be noticed by some, it seems that it shall have to form part of the present notion of integrated color sensitivity. That is, if the individual notices a change in himself as well as a change in his perception of the world in a color perception situation, and if these two are noticed as inseparably connected, then a certain degree of integrated color sensitivity must be said to exist.

Peak experiences with color as major stimulus

A type of experience which is of special importance to the individual who has it is sometimes called a peak experience (Maslow, 1962). Often the individual is able to quite specifically state which sensory stimuli contributed to making that particular experience a peak experience (Bindrim, 1968) and, although this concept will not be explored in the present thesis, it is interesting to note the implications of further thinking along these lines.

To possess a degree of integrated color sensitivity entails a certain amount of enjoyment of color for its own sake. It seems clear that Cēzanne, for instance, was not merely a technician working out of convenience with color for some ulterior purpose. Rather, the dimension of color was his dimension, per-

haps because it initially suited his style, temperament, or objectives well, certainly because he came to have intimate knowledge of it, and probably because it gave him great pleasure to work with. A relationship of love probably developed between the painter and the dimension of color.

This type of love relationship seems to be a very fruitful situation in any type of investigatory enterprise. Maslow (1969) in an offhanded fashion proposes the following hypothesis: "love for the object seems likely to enhance experiential knowledge of the object...". (p. 51) It is based on an acceptance of one's own nature, as he points out, instead of attempting to live up to some external ideal. The resulting emotional maturity enables one "to give oneself over completely to an emotion, not only of love but also of anger, fascination or total surrender..." (p. 38) to the problem at hand.

How this deeper emotional involvement with color is to be understood in the present context is somewhat problematic. Many people, of course, enjoy color in one form or another. What is here being emphasized is the enjoyment of color for its own sake. And yet, as in Cēzanne's case, it seems that color might only be enjoyed for its own sake insofar as this perceptual experience leads to the solution of even more fundamental problems such as the reorganization of space on a two dimensional surface, etc. But perhaps that is the extent to which one is able to enjoy

color for its own sake: insofar as it figures prominently in some major present concern, that it, as a dimension of the world, takes on a role of the dimension at a particular time, and that it leads to a color-centered experience, or a peak experience, with color as the prime stimulus involved.

Many people have at various times and under various circumstances in their lives these peak experiences. What is in particular being suggested here is that integrated color sensitivity by its nature of internalization, actualization, love-relationship, etc. may embody the idea of peak experiences due specifically to color. Thus it is consistent with the notion of color as a priority. Furthermore, the creative aspect of color perception is involved. Schachtel (1959) writes:

> What has been learned [through the creative process] in such unfettered and open intercourse with the world may... crystallize suddenly in an insight, or in a new vision of something that seemed long familiar, or in an "inspiration." (p. 142)

And this type of creative insight falls well within Maslow's (1962) notion of a peak experience as, among other things, involving basic cognitive happenings such as nature experiences, aesthetic perception, creative moments, and so on. (p. 69)

Summary definitions

The following set of definitions of the four dimensions of integrated color sensitivity as they relate to individual abilities, are the basis for subsequent experiments and analysis:

1. Individuating through color The ability to (1) distinguish between objects, persons, events and other 'items' of the real world through their coloration, and (2) perceive the uniqueness and individual existence of these items through color.

2. Personal color perception The facility with which the color world is perceived (and sensed to be perceived) in terms relating to the perceiver rather than to those of his society.

3. Actualized color perception The ability to conceptualize, through color perception, facts about reality through an open, receptive and passive perceptual attitude.

4. Transactional color perception Awareness that a transactional relationship between the individual and the color stimulus at hand exists in the color perception situation.

II INTER-STRUCTURE

Introduction

A cursory examination of how the term 'color sensitivity' is used in different scientific contexts will show that color sensitivity has a number of meanings. In the brief comparison between integrated color sensitivity and two other types of color sensitivity which constitutes this section, two main problems will be dealt with: (1) the type of structural relationship which might exist between integrated color sensitivity and other kinds of color sensitivity, and (2) the extent to which existing stimulus specification systems are adequate for the characterization of the present concept of integrated color sensitivity. The justification for the inclusion of this second problem in the present section will become apparent shortly.

It is further noted that in any treatment of a term such as 'color sensitivity', the two distinct parts, i.e., 'color' and 'sensitivity', may have to be treated separately. Presently, 'sensitivity' is dealt with and, for the time being, 'color' will remain unspecified.

Psychophysical color sensitivity

Psychologists often refer to an individual's ability to perceive of colors as the color sensitivity of that individual

(Valentine, 1962). They may for instance say that a person is less sensitive to a certain area of the spectrum (e.g., if he is not able to distinguish between slight hue nuances in that area of the spectrum), and thereby displays a particular type of color vision deficiency. Or, an individual's color sensitivity may be determined through his ability, or lack of it, to match one colored light source with a combination of one, two or three other colored lights. Depending on the test procedure used, and to some extent on the theoretical viewpoint of the researcher, terms such as normal, color weak and deviant are used for describing differences or degrees of color sensitivity (e.g., Pickford, 1951). The psychological investigations are essentially concerned with the normal or abnormal functioning of the physiological, optical mechanism. It may be quite physically oriented as when the color stimulus is specified in terms of wavelengths; it may be psychophysically oriented as when a physical model is combined with a standard observer, such as in the C.I.E. (Commission Internationale de l'Eclairage) system of specification, or it may be purely psychological, in which case the standard observer of the psychophysical orientation would be replaced by the individual, unique subject.

The physical (i.e., strictly physiological or biological) and the psychophysical types of investigation differ from that presently undertaken in that the concern here is not so much

with what the 'standard' individual's optical apparatus enables him to see, but rather with what the unique individual does see, and what use he makes of what he thus sees. The present investigation is of the psychological type insofar as the focus is on the individual's unique response to color stimuli. At the same time, evidence for this response will be sought in the behavior and behavioral change in the individual rather than in the modification or manifestation of deeper personality characteristics.

The kind of structural inter-relationship which appears to exist between psychophysical and integrated color sensitivity--the latter being determined and perhaps restricted by the former--now dictates that as a minimum requirement for the investigation of integrated color sensitivity, an assessment of psychophysical color sensitivity be included in the present series of experiments.

Learned color sensitivity

Another kind of color sensitivity involves color sensitivity as a learned habit (henceforth simply to be called 'learned color sensitivity') in which the individual in particular circumstances displays a greater than normal ability to precisely and quickly discriminate between, say, samples of cloth or printed colors. This type of ability is of practical importance to industry dealing with dyed materials, and in

printing establishments where either a close match between an artist's sketch and an ink color must be obtained, or where the so-called color correction etching of separation plates must be carried out. Research into the color vision requirements for workers in these areas has been done for instance by Lakowski (1965). In connection with the examination of printers' apprentices, his principal task has been one of screening aspiring printers by establishing standards for performance on batteries of color vision tests. The basic assumption here is that, although it may take practice to attain the high degree of practical color discrimination required in a particular trade, the prerequisite for such a goal to be reached would be a color vision performance falling within quite narrow limits of normality.

It is a question of whether the kind of practice which is meant here is of the type exemplified in a study by Hanes and Rhoades (1959) in which one subject after about five months of intensive training increased her ability to identify color chips (that is, in this study, to name them according to the Munsell notation) from 15 to 50. After a period of 3-1/2 months, during which no color identification was practiced, her error score increased about 25% however. The identification capability of 50 colors is considered rather disappointing by the authors, although it is generally accepted that the average person is

only able to identify about 15 colors.

The kind of practical ability to discriminate between colors, rather than involving ability to name colors, seems to consist of an ability to match accurately one color with another, (1) in cases where both colors are present, and (2) in cases where only one color is present and the 'standard' is memorized. At the same time, however, there may be evidence for the fact that ability to simply identify (which could be considered different from naming in general, and certainly from naming in the somewhat terse Munsell terminology) does have something to do with the second case of color discrimination to the extent that the process of memorizing may need some sort of cognitive identification framework.

If it can be assumed from the discussion in section I that a painter who is termed a colorist has some level of integrated color sensitivity (since his world by definition would be primarily color oriented), then it seems reasonable to argue that both cases of learned color sensitivity must also apply to him.

First, the artist's color matching ability in cases where both colors are present must be well developed. Evidence for this may be gathered for instance from examining Renoir's palette which only contained eight or ten pigments (Renoir, 1962), and making a comparison between the skin tones of the numerous nudes which he painted during the latter part of his

life. Although a change due to gradual development of 'vision' as well as occasional concessions to the individuality of particular models are in evidence, it is still clear that a greatly uniform rendition of flesh tones was produced over a lengthy period of time from a very limited number of pigments.

Secondly, it seems unreasonable to assume that Renoir's ability to reproduce his particular colors would depend on him having his latest paintings present with which to compare his new work. His sense for memorizing these complex color mixtures must also therefore have been quite well developed.

But integrated color sensitivity, of course, is much more than just these two specific abilities. As was pointed out earlier, at least four distinct dimensions could be involved. It seems that learned color sensitivity need not embody any of these. It may in fact be the case that continuous, and perhaps rather mechanical, use of this type of color sensitivity in factories will dull or diminish aspects of integrated color sensitivity. At the same time, learned color sensitivity might in some cases include some of these dimensions, and this fact gives rise to the idea that learned color sensitivity, theoretically at least, might be regarded as an intermediary step toward integrated color sensitivity. That is, there may be a point in the assessment of an individual when the characteristics of both learned and integrated color sensitivity are involved to such an

extent that the determination of which type is involved must be arbitrary or, at best, a question to be decided on some sort of priority rating of the four dimensions. No such attempt at ranking will be made in the present study.

The problem of 'mistaken sensitivity' is of particular importance to artists since to possess only a well-developed learned color sensitivity and not a well-developed integrated color sensitivity is precisely the difference between being creative (i.e., colorwise) and not being so. Accurate color rendition of a landscape, for instance, does not necessarily mean that a work of creative merit is involved. Again, it may be, if other dimensions are of a creative nature, but speaking only about color, if the colors of the work are 'accurate' (i.e., of a nature which culturally would be considered true to life), then it is safe to assume that color is not creatively involved. Thus, learned color sensitivity can be seen as an ability competing with integrated color sensitivity as well as one which can precipitate its development.

Since the present thesis is not primarily concerned with the determination of an individual's learned color sensitivity--even though an argument has been produced for its developmental role in integrated color sensitivity--this particular sensitivity will not be further examined here.

The problem of stimulus specification

The second question with which this section is concerned is that of the adequacy of present paradigms for the full treatment of integrated color sensitivity. It follows from what has been said above that color vision tests may give a good idea of the extent to which an individual can acquire learned color sensitivity, at least insofar as the spectral distribution is concerned (cf. error score profiles for instance in Farnsworth, 1943) and perhaps also insofar as size of unit which can be discriminated is concerned (Wright, 1969). It has for a long time been a prime aim of color psychologists to specify the stimulus in question as accurately as possible. Pitt (1935), for instance, writes: "In a subject dealing with the... psychological responses to physical stimuli, it would seem to be axiomatic that these stimuli should be stated with the utmost precision...". (Preface) This invariably involves the specification of the color stimulus in a form borrowed from physics. And Lakowski (1969) notes how objective measurements are best secured by avoiding "subjective awareness of different sensations" (p. 186), i.e., by precisely specifying the color stimulus and adopting the psychophysical paradigm for the assessment of the subject's responses. The problem, however, in the present case is of a peculiar sort. For example, since the first dimension of integrated color sensitivity (i.e., that of 'individuating through color')--and since this dimension

is not detachable from the other dimensions of the concept, but an integral part of it--involves the notion of creativity in the sense that existing paradigms are destroyed and new ones sought, it follows that the existing physical color specification systems, as they are presently stated, may not adequately indicate the stimuli involved in integrated color sensitivity.

The problem of attempting to sort out precisely what psychologists mean by the term 'stimulus' has been well surveyed by Gibson (1960). Apart from pointing out numerous conflicting conceptions of stimuli, he offers some insight into part of the presently suspected connection between the stimulus and the response (or 'sensation' as Pickford (1951) terms it). He notes that: "Learning would... involve not only an alteration of behavior but also an alteration in the effective stimulus." (p. 202) Presumably this would hold for the present notion of creativity as well, in the sense that any change from a present state of integrated sensitivity (or learning or creativity) would, apart from the more obvious behavioral change, necessitate a different view of the effective stimulus. And by 'effective stimulus', Gibson means precisely the stimulus "which arouses receptor activity, or recorded neural impulses, or sense organ adjustments, or overt responses, or verbal judgments--whichever criterion one chooses". (p. 203; Italics mine.) That is, the concept of the stimulus is 'floated', as it were, and left to find

its own meaning depending on the response in question. This conclusion would seem to support the view taken by the present writer that a system of specification of the stimulus, however sophisticated it may be, is only applicable to the type of responses which by definition are elicited by the stimulus.

The problem is made somewhat more manageable by recalling Merleau-Ponti's (1961) criticism of the 'ideology of cybernetics':

> Thinking "operationally" has become a sort of absolute artificialism,... where human creations are derived from a natural information process, itself conceived on the model of human machines. If this kind of thinking were to extend its reign to man...; if, pretending to ignore what we know... [of man] through our own situations it were to construct man... on the basis of a few abstract indices... then, since man really becomes the manipulandum he takes himself to be, we enter into a cultural regimen where there is neither truth nor falsity.... (p. 160)

This is of course not to say that existing color specification systems do not have their value; the point rather is that, by definition, one knows (or ought to know) what their value will be before their application. About a typical color system, be it the physicists' electromagnetic spectrum, the Ostwald, Munsell or C.I.E. system, it is usual to say that all possible colors will be found within certain particular boundaries. And this is indeed true as long as one limits oneself to conceive of colors only in terms of these existing paradigms. At the same time, the person who is creative (in the particular sense

described) cannot be confined within these precisely defined boundaries.

The practical implications of this argument are problematic. On the one hand, the present systems supply a valuable precision in the specification of color stimuli when color vision tests are involved, and when the concern is with learned color sensitivity. On the other hand, they may blind the investigation to aspects of integrated color sensitivity which truly go beyond conventional views. The only solution presently available is to employ the existing paradigms to their maximum possible extent, and to keep in mind the possible inadequacies of these same procedures.

CHAPTER III

PILOT PROJECTS IN INTEGRATED COLOR SENSITIVITY TRAINING

The second major part of the thesis concerns itself with the proposition that certain training techniques can be shown to heighten an individual's integrated color sensitivity. This chapter describes a number of techiques which the writer had occasion to use during a series of one week courses in the summer of 1972, as well as a shorter course in the fall of that same year, and which furthermore--judged informally--seemed to enhance or heighten in the students that ability covered by the rather vague concept of integrated color sensitivity which the writer had at that time. The presentation will take the form of excerpts from the writer's diary, and will cover both procedures and informal comments made by participants about the seeming success of techniques used.

The following excerpts from the program notes show the scope and direction of the projects:

> The purpose of this exploration will be to create in the participants an awareness that there is such a thing as level of visual sensitivity, that this level may be dependent upon the individual as well as upon the individual's cultural environment, and that it may be possible to raise this level of visual awareness to greater heights.
>
> A variety of visual experiences will be provided--and a number of perception and communication 'games' entered into--in order that the individual may reach a higher level of visual awareness.

A wide variety of experiences which were 'unusual' to most of the participants were provided, and the rationale for this procedure was based on Jourard's (1968) ideas that personal growth occurs when existing concepts are broken down and the individual is forced to construct new ones.

As a further testimony of the possibility of heightening one's sensitivity, one might quote Angyal (1962) who, although he does not indicate precisely what triggers this process of growth to occur, writes:

> Even the most common objects were endowed with an unsuspected beauty; it was as if they were seen for the first time, as if they had been never <u>really</u> seen before....
>
> These perceptions had the immediacy and depth of emotional experiences but at the same time they were easily translatable into thought.... The 'translation' developed easily and naturally and appeared to be a true expression of what the thing really was, a plain straightforward statement about its nature.
>
> The perception of a tree includes also the volume of air between its branches; although I had possessed theoretical knowledge of the perception of space, it was actually only during this period that I started vividly noticing space and perceiving its color. (p. 123)

There were slight variations in the procedures and techniques used from week to week, and the following represents an account of a typical five day course:

<u>Day 1</u>

I begin by explaining Carl Rogers' therapeutic method of non-directive counselling, and give a brief demonstra-

tion of what 'positive' and 'negative' listening is like. The parallel between positive listening and 'positive' looking is then introduced. The group shows great amazement that it is even possible to talk about looking in this way. I then mention Maslow's Taoistic method: the passive, non-interfering kind of observation which is very much like the positive kind of looking. Some confirm that you do seem to get a lot more out of nature, for instance, if you just let it happen to you instead of imposing yourself on nature. The story of Paul Klee is brought up: how he used to watch the forest until suddenly he felt that the trees were looking at him.

When positive perception is so pleasant, why then do we often perceive negatively? That's a good question, the participants thought. Perhaps because we've learned to perceive in this fashion someone suggested.

This brought me to the role of past conditioning as a dominant factor in our way of seeing the world. Most of us don't realize it, but even the three dimensions of space are not exempt from this. Space could theoretically have any number of dimensions as Merleau-Ponti points out.

Ecology and positive perception is mentioned, and it is thought that once you learn to see more, you don't destroy so much. Further, a higher sensory awareness seems to be a

prerequisite for a higher social one.

Experiments

(1) We divide ourselves into groups of two and are each supplied with a set of 8 color chips. These chips were similar to the 8 colors used in the 'Short Lüscher Test' (Lüscher, 1969; 1971), and were obtained by cutting into 3" x 4-1/2" chips large 'Truprint' sheets produced by Schmidt Printing inks: dark-blue no. 131TP; blue-green no. 110; orange-red no. 130TP; black and neutral grey no. 1200TP; bright yellow no. 130TP; violet no. 120 TP and brown no.110TP.

The object is now to start a conversation with your group member by simply handing him a color swatch. What do I want to say? Try saying: I'm fine, how are you? Or: This is me, what are you like? This should all be done without words. It seems to work amazingly well in spite of a few difficulties in understanding my instructions. Mainly this was due to the surprise many expressed over my request; they just didn't think it was possible to get anything out of 'talking with colors'. And yet they found to their surprise that many were quite eloquent at expressing feelings through this medium. In some cases there were contradictions of meanings, but usually this was because some of the participants did not let their emotions rule their color choice; rather they tried to find culturally learned

colors to match some thought already conceived. Labels such as 'happiness' also caused some misunderstandings. Opinions about which color to affix to happiness varied considerably, yet simply feeling happy in a more non-descript way usually came across in the color choices. Some intellectualized too much; why wouldn't they let go and simply feel the colors? They'd enjoy it so much more. But no! Colors must have 'meanings', and unless we know those specific meanings, we can't talk. But look! It really works in spite of the fact that we don't have a 'color dictionary'.

(2) The first experiment focused on saying 'nice' things to each other. This time we try to put someone else down with colors. What does it really feel like to be put down or turned off with color? This experiment seems to work even better than the previous one. Perhaps it's because we are gaining experience, or perhaps it is because it really is easier to speak negatively through color. I suspect that one is as easy or as difficult as the other. Seems really devastating to be put down with color. If you tell me the same in words, I can argue back at you. But colors come from the heart. I feel really hurt because you really seem to mean the put-down. I get angry and start throwing down my color replies. I'm sorry for

taking the 'conversation' so seriously; it's just a silly game, and I must have lost my temper. Silly bits of paper can really get you going. Again, we have an example of the 'indifference' or lack of values in a mode of communication. In a sense, the color swatches are as indifferent as computer bits, and yet they are loaded with emotional meaning. Negative talk with colors can also be indifferent talk: you talk about yours and I talk about mine. That's pretty frustrating too. And it really works.

(3) We try to assign colors to the following: someone I love or hate, peace, freedom, the way I sit, I want to get to know you. Our favorite colors are usually chosen for things we considered good. Thus there is a good variety of responses to each of these questions. In some cases a third person view is adopted and culturally accepted colors are assigned instead of personal ones. Not so good qualities are generally related to less liked colors, although rejected colors (of the 8 Lüscher colors) are not used. No black for instance is used. We finally make an assessment of what color we think appropriately expresses our feelings about the group right now. [A variety of colors are assigned to the group, and no analysis has as yet been made of these responses.]

Day 2

We start out by discussing what could be meant by a body image, and I make reference to Schilder's (1935) concept of this idea which we supposedly carry around with us: the idea of what our body image is like. This apparently changes constantly and is equally influenced by how we conceive of ourselves and by how we see ourselves in others. The notion of the transactional situation between us and others (and the world) is brought up: how when we work a lump of clay we do things to the clay and the clay does things to us. Do we really know what we look like? Do we ever stand in front of a mirror and take a really good look at ourselves (Lewis and Streitfeld, 1970)? How much of what we see is determined by what we'd like to look like?

Experiments

(1) We first do a drawing project in groups of four or five. The reaction is generally favorable. The younger people in the group seem more inclined to make a group project out of it. The more mature seem to establish a theme and then to make their own drawing as a part of this theme. Two general kinds of individual seem to emerge: those who attack the drawing with determination (and who put a decisive pressure on the crayon) and those who prefer a more cautious approach (and who keep their drawing light

and sketchy). Rather mundane themes are chosen: a nice day by the lake side, their surroundings in Naramata where the seminars took place, etc.

(2) We end up the session by doing a self-portrait. Can we make some sort of a graphic statement which others can see us in? Some succeed extremely well. One woman drew a light and gentle flower, and without knowing who had done it, there was general consensus that she was the artist. Others made cartoon-like drawings which only seemed to exhibit characteristics of the subject suitable for public discussion. We could generally recognize who it was, but we felt many times that a more honest portrayal would have been better. The business man, for instance, in black crayon and a business suit: would colored butterflies flutter out from his inside if we opened up his suit? Color was of no particular importance to him, he claimed. And yet he had chosen black. Why? [He later told me that he is quite color blind, but unfortunately he was not able to tell me precisely which type of color defect he had.]

There was a real fascination derived from this experiment. No one had done this before, and it was a real eye-opener to many. I felt that their visual awareness of themselves at least rose considerably during this experiment. [In the days which followed, many spent much time

trying to come to terms with and perhaps justify the self-portrait they had produced.]

Day 3

(1) We do what has been called 'color breathing' (Ouseley, 1949) first today. We sit outside in the sun facing a large tree which is predominantly light green. By bending forward we expel most of the air from our lungs; then as we slowly sit back up, we inhale. As we sit upright in a relaxed position we hold our breath - all this while making a conscious attempt to soak up the particular green of the tree the way you'd drink vegetable juice or eat celery. After the initial deep breath, we simply sit for five minutes and 'take in' the tree-green while trying to breathe deeply and slowly. We try to imagine the green color of the tree as a sort of radiation which we in turn, then, are trying to absorb.

After this, we turn our attention to a darker green bush and repeat the procedure. How does it feel? Strange and unfamiliar at first. In the end, not quite so strange, and certainly more familiar. We feel that we really are getting to know that particular green we are looking at. There are comments about being a little more in touch with what is out there. However, it is realized that it may

take a little longer than ten minutes to achieve noticable benefits.

(2) The second part of this session is devoted to an exposition and explanation of the Short Lüscher Test (Lüscher, 1971). First, everybody makes a color selection in his order of preference. This is written down (each member keeps a record of his or her own selection). I then briefly explain (1) Lüscher's way of scoring the selection, and (2) his interpretation of the selections. I insist that the selections be kept private. I want to make them aware of the wealth of information a psychologist might gain from the selections, as well as the therapeutic use to which each member might put the interpretation of his or her selection. I further mention (citing Lüscher's reasons) how a normal, healthy individual ought to place the four psychologically primary colors in the first five places of the selection, and that if they did not occur in these places, it might be beneficial for the individual to specifically work on those colors. The method for therapeutic action I suggest is that of color breathing or color meditation. If for instance the green of the test occurs in the 6th, 7th or 8th place, it might be beneficial, I suggest, to 'think green', to meditate on that particular blue-green of the test in order that it may become more familiar and

thus hopefully find a more prominent place in that individual's life. My claim is that once you know which colors you 'reject' and for which reasons, learning to care for and indeed to love that particular rejected color might simultaneously effect a physiological change in you which will reflect a move toward normalcy and health. [It should be added that I have no organized evidence for the effects of this type of therapy at all. However, insofar as colors and their effects are concerned, such as in the above experiment, it is of no consequence whether the therapy works or not.]

Most of the group are especially skeptical about the suggestion that meditating on a color will actually change them (i.e., 'deep down'). I can only remind them of the effects achieved through school rooms painted green, through changing your living room carpet from, say, pale blue to deep red, or selling colorful bonnets instead of plain black hats to elderly ladies. [With one group, much less skepticism was expressed. This group was particularly interested in arts and crafts--many of them were amateur painters-- and it is possible that even a limited practical facility with, for example, color mixing makes a person more receptive to ideas such as color breathing and the deliberate, therapeutic use thereof.]

Day 4

(1) We do breathing as yesterday and focus on a large tree. We're sitting on the lawn, and to set the mood I suggest that they become aware of their weight on the ground--how they at this very moment are flattening hundreds of beautiful grass stalks--and of their posture. We relax. Today we soak up the greenery for 2 minutes. We then close our eyes and imagine the same scene bathed in brilliant sunset colors--reds, oranges and yellows--for another 2 minutes. After that, we take in the original scene for another 2 minutes. We are beginning to feel the first green as warmer and more friendly than the last green. Also, contemplating the image of the sunset colored scene makes you feel a little hotter than meditating on green. In fact, thinking red makes you not notice the slight breeze at all. As soon as green is returned to you, you feel the breeze.

(2) We gather indoors in a completely dark room and spend some time walking, feeling our way around the room. We talk and we sit down and relax. The idea is to provide an antithetical experience to the visual ones provided so far: from our visual world to that of the non-visible. We go out into the sunshine again, and we notice with excitement what we had left behind when we entered the dark. The colorful environment--which some of us took for granted

before--now demands our full attention. This exercise seems to make the point well that colors (and light) play such a great role in the 'creation' of our world.

Day 5

(1) Today we try our color meditation indoors, but with the same steps as yesterday. We subsequently imagine both the green and the red scene. And to most people's surprise, we begin to feel the same effects as we felt outdoors before. We actually experience a sort of mind over body effect. The seminar room is awfully hot, and by thinking green we actually begin to feel a little cooler. And conversely, by thinking red, we become painfully aware of the stuffy hot air in the room.

(2) I show slides of the underside of tree crowns; I then show the same scene out of focus. We realize how by 'blinding' one aspect (the sharp, detailed part) of our vision, we can see so much more than before. We look at another slide in focus and attempt to estimate distances between foreground and middleground. When this slide is put out of focus, we lose the scale of measurement. We are no longer able to communicate distances about the scene in front of us to each other. And yet we feel a different sense of distance which we cannot explain. That is how a

very advanced artist must feel; he may be so far out in front that his language is no longer understood by his contemporaries. He may even be judged mad.

We then look at optical illusions in the works of Riley, Albers and Vasarely. Here's something going on which we don't particularly intend to see, and yet which we can't help seeing. It does not seem to be learned like so many other things we see. People who have never seen this kind of 'op art' before are very inpressed, and we realize that 'hard edge' painting can be very soft indeed when we adjust our eyes in certain ways. We begin to see things which we never thought possible to see before. We talk about continuity and discontinuity: I point out that nature is 'continuous'. Man-made techniques like printing seem to be 'bitty' and discontinuous, but we must not let this lack of technical sophistication influence our way of looking at the world. Even though the movie camera 'sees' the world in 24 pictures per second, we must not let ourselves be led to believe that this 'flickering' view of the world is the only possible one. We must constantly question who and what made us see things the way we see them. We talk about awareness and how many in the group have come to a greater awareness that there is really a lot more to see out there than usually meets the eye. This, we conclude, must be the

first step toward a heightened visual sensitivity. The groups are quite excited about it: here's a whole world full of visual stuff which they were never really aware of. And there furthermore seems no limit to what really is there. We end by attempting to distinguish between looking and seeing. We conclude that the more you look, the more you see.

This concludes the day-by-day account of a typical visual awareness course which the writer gave to five different groups over a five week period during the summer of 1972. The total number of participants over this period was approximately 200, and their ages ranged from 17 to about 70 years.

In summary, the typical five-day course contained the following specific techniques:

1. Discussion of positive/negative looking and possible influence of past conditioning.
2. Positive/negative color talk.
3. Assignment of colors to different concepts.
4. Discussion of body image.
5. Group drawing project.
6. Self-portrait drawing project.
7. Color meditation.
8. Short Lüscher test.
9. Dark room experience.
10. Slides.

In the light of one subsequent course in the fall of 1972, which for practical reasons had to be limited to a total of 10 hours, a re-evaluation of the above ten techniques has been made. The following techniques (numbered as above) have been found to convey the essence of the material in the allotted time: 1, 2, 3, 6, 7, and 10.

These re-evaluated techniques will be discussed briefly and refined to a greater extent in chapter V, section IV.

CHAPTER IV

HYPOTHESES AND RESEARCH QUESTIONS

As a result of the theoretical considerations of chapter II and the pilot studies reported on in chapter III, the following hypotheses and research questions are advanced.

I HYPOTHESES

1. It is hypothesized that the subjects who undergo the sensitivity training session will make a significantly greater number of individuations through color than those subjects who do not participate in the training.

2. It is hypothesized that the subjects who undergo the sensitivity training session will show a tendency toward a more personal color perception compared to those subjects who do not participate in the training.

3. It is hypothesized that the subjects who undergo the sensitivity training session will show an increase in actualized color perception compared to those subjects

who do not participate in the training.

4. It is hypothesized that the subjects who undergo the sensitivity training session will show an increase in transactional color perception compared to those subjects who do not participate in the training.

II RESEARCH QUESTIONS

In order to examine to what extent color discrimination ability is a factor in the performance on the four dimensions of integrated color sensitivity, samples of experimental and control subjects of high and low color discrimination ability will be defined (cf. chapter V). The four groups to be defined are identified thus: Hi-E, Lo-E, Hi-C and Lo-C, where Hi and Lo refer to color discrimination performance and E and C refer to experimental and control respectively.

Since one can only speculate about possible effects which may emerge as a result of this latter examination, no hypotheses are advanced. Instead, a series of questions, which are repeated in substance for each of the four dimensions of integrated color sensitivity, are posed.

1. Is there a difference between the performance of

1.1 Hi-E and Lo-E

1.2 Hi-C and Lo-C

1.3 Hi-E and Hi-C, and

1.4 Lo-E and Lo-C samples

on the dimension in question?

2. Does the sensitivity training have any effect on the post-training performance of these samples?

In addition, the following questions relating to what use the subject makes of his psychophysical color discrimination ability are raised.

1. Is there a difference between the extent to which experimental, control, Hi-E, Lo-E, Hi-C and Lo-C samples select colors which fall in areas of the spectrum where good discrimination exists for individual subjects?

2. Is this performance affected by the sensitivity training procedure in the case of the main experimental, the Hi-E, and the Lo-E samples?

CHAPTER V

RESEARCH DESIGN

I THE SAMPLE

The sample was obtained by inviting university students enrolled in a teacher training program at Simon Fraser University to participate in a project involving color and personal development. The benefits to the participants were advertised as including a gain in knowledge about their perception of themselves, others (e.g., their students), and the world. Due to the subjects' professional interest in the project as a learning (and teaching) experience, a debriefing session was conducted after the conclusion of all the experiments during which training techniques used were explained in detail.

The full sample consisted of 26 individuals, and these were assigned to an experimental and a control group at random as they presented themselves for testing.

The experimental group, numbering 15 subjects, and consisting of 9 females and 6 males, had a mean age of 25.3 years (range 19 to 42 years) and a mean score on the Farnsworth-Munsell 100-Hue Test (hereafter called the color discrimination score) of 61.8 (range 0 to 275) with a retest mean score of

43.8 (range 4 to 145).

The control group consisted of 11 subjects, 7 females and 4 males. This group had a mean age of 23.18 years (range 20 to 26 years), a mean color discrimination score of 32.1 (range 0 to 96) and a mean retest color vision score of 17.5 (range 8 to 44).

II PRE-TRAINING TESTS

Two separate measurements were made: psychophysical color sensitivity testing and integrated color sensitivity testing. This was in accordance with the conclusions reached in chapter II, where it was pointed out that a more comprehensive understanding of an individual's integrated color sensitivity may possibly be gained through a comparison with his psychophysical color vision ability.

Psychophysical color sensitivity test

The purpose of this test was to ascertain to what extent the subject is able to physiologically discriminate between colors.

Because of the relative simplicity with which the test can be administered, and in order to keep the testing time within a reasonable limit, the Farnsworth-Munsell 100-Hue Test (100-Hue) was employed (Farnsworth, 1943; 1957). It is a color vision test utilizing the surface mode of presentation, and its main virtue is

that it can, besides detecting color confusions, indicate minute differences in color discrimination in deviant as well as in normal observers (Lakowski, 1969). The latter ability of the test was especially useful here since, in part, physiological color discrimination performance is an ability which it was desirable to compare with integrated color sensitivity scores. Furthermore, since the present testing was not so much concerned with diagnosing particular color deficiencies as it was with the representation of the subject's color vision discrimination profile in an easily comprehensible form, the 100-Hue test served admirably.

The 100-Hue test consists of 85 Munsell color chips distributed within the C.I.E. color space as shown in appendix B. Each matte color chip of 1/2" diameter is mounted in a dull black bakelite cap, 1/8" below the cap's top edge, and surrounded by a 1/8" wide rim. The total number of caps is divided into four nearly equal lots which are contained in four cases, each case containing the first and the last cap of adjacent series which cannot be removed. The four cases contain the following numbered caps: 1-22, 22-43, 43-64 and 64-1. The loose caps are removed from the case and presented to the subject in a random order which, according to Lakowski (1969), should be the same every time the test is administered (cf. appendix B). The task is for the subject to place the removed caps in the cases (one case

at a time) in a consecutive or smooth color order between the two fixed caps beginning and terminating the series of that particular case. Colorimetric data for the 85 caps is to be found in appendix A.

The test has a peculiarity which may be seen both as an advantage and a disadvantage in the present context. The 85 Munsell colors which have been chosen for the test (Farnsworth, 1943; Nickerson and Granville, 1940) are placed in the color space in such a way that they are approximately equidistant from the C.I.E. illuminant 'C' (i.e., 6750 K) with the result that only the hue varies between the color chips, and chroma and value remain approximately unchanged for the normal observer (5.18-5.99/4.4-6.0 in Munsell's re-notation; 5/5 according to Nickerson and Granville (1940; 6/6 according to Lakowski (1969)). The advantage to this design is that only the variable of hue is tested. The disadvantage perhaps is that 'color sensitivity' in this case might be really regarded as 'hue sensitivity'. Howevever, considering the test's power to detect a wide variety of color defects (Lakowski, 1969), and that Farnsworth (1957) himself states that the test is for the examination of color discrimination, it is perhaps fair to say that in spite of its above mentioned limitation, it still affords a convenient and reliable way to quickly assess a person's psychophysical color sensitivity. This argument will also justify the use of the 85 Munsell colors later in the specification of

test stimuli.

Lakowski (1969) points out that the 100-Hue test is a "relative measure of colour discrimination and therefore certain criteria or reference standards are necessary against which to evaluate the given individual score or configuration." (p. 274) Farnsworth (1949, 1957) employs as one standard for color discrimination ability the terms superior, average and low discrimination, and standard values for the error scores associated with these categories are given. However, since the scores obtained from the 100-Hue test were used in part in the selection of reasonably homogeneous samples for statistical analysis, reference standards found by Verriest (Lakowski, 1969) were found most useful. These are discussed in chapter VI.

Test administration and directions

The test was presented and explained to the subjects in the standard way as recommended by Farnsworth (1949, 1957).

A booth type of structure made from neutral gray card was used to screen off distracting background and to ensure that no undesirable color reflections fell on the work area. The lighting employed was daylight type fluorescent lights with an approximate color temperature of 7000° Kelvin (General Electric, type F-40D).

Scoring

The test was scored in the usual manner (Farnsworth, 1957), the error score for each cap being the sum of the difference between the number on the back of the cap and the numbers of the two caps immediately adjacent to it.

Integrated Color Sensitivity Test

This test was designed specifically for the present study, since no existing test endeavors to measure the previously discussed four dimensions of integrated color sensitivity. The test will be called the ICS Test (Integrated Color Sensitivity Test) for convenience.

Description of the ICS Test

The purpose of the test was to assess the level of the individual subject's integrated color sensitivity separately on a set of four dimensions.

The subject was supplied with four sheets of paper, each displaying a black and white picture reproduced from a photograph on a Xerox copier (cf. appendix B for samples of these pictures), and a case of 29 felt markers which had been matched to 29 of the 85 Munsell colors used in the 100-Hue test. (See appendix B for a full description of physical properties and colorimetric data.)

The subject was asked to study briefly the first picture and then to color it using the markers available which most appropriately expressed the way he saw the picture. It was further mentioned that the picture must be completed within a two minute time period, since it had been the writer's experience that if given no time limit, a subject will not respond very spontaneously, nor will the finished product adequately show differences in number of colors used between different subjects. The coloring procedure was repeated for the remaining three pictures.

After the coloring task was completed, the subject was asked two questions (cf. 'Directions' below).

The experimenter assessed the subject on the dimensions of actualized and transactional color perception during the task and these scores, the numbers of the felt markers used, and the tape recorded answers to the two questions were kept for subsequent analysis.

Criteria of integrated color sensitivity

The ICS test was primarily aimed at assessing the individual's 'creativity' as far as colors are concerned. However, the sense in which 'creativity' was used here was a very special one as mentioned in chapter II. This is particularly noticable if one compares the ICS test with Torrance's (1966) tests of non-verbal creative thinking ability. Torrance's notion of creativity is

founded upon the individual's need, when confronted with one of the completion tasks, to create something unusual, whereas the present test was not so much concerned with urging the subject to create something unusual but rather with assessing what the individual did in an ordinary situation (or as ordinary as a laboratory setting allows) with colors.

Furthermore, the present notion of creativity was not tested directly. Instead, the four specific dimensions which were shown to be derivatives of creativity were tested.

It should also be noted that 'priority of color' (cf. chapter II) was not tested directly. Like the concept of creativity, priority of color acted as part of the analytic underpinning of the constructed concept of integrated color sensitivity. It was thus only tested indirectly through the four dimensions previously mentioned.

Specifically, the four dimensions tested were:

1. Individuating through color,
2. Personal color perception,
3. Actualized color perception, and
4. Transactional color perception.

1. Individuating through color. The subject was expected to individuate between objects, persons and events depicted in the photographs through the use of color. The more individuations

he made, the higher level of integrated color sensitivity he was said to have.

In picture I, objects of the still life (i.e., the oranges) had to be individuated.

In picture II, the different persons (i.e., children) as well as the generally cheerful mood of the event had to be individuated through color.

Picture III, the landscape, was not used in the assessment of this dimension of integrated color sensitivity.

In picture IV, persons as well as the predominantly dramatic nature of the event were expected to be individuated.

2. Personal color perception. It was assumed that the higher the subject's level of integrated color sensitivity was, the more personal or ideosyncratic his color choices in felt markers would be. The extent of the subject's personal color perception was assessed from his performance on all the pictures.

In picture III, for instance, a culturally oriented person might feel compelled to color the sky blue, the grass green, etc., since these are the colors usually associated with these items. The subject with a higher level of integrated color sensitivity, on the other hand, would be expected to deviate from these norms.

Pictures II and IV show two contrasting events as far as mood is concerned. The one shows a group of children who are

clearly enjoying themselves. The other shows a dramatic scene --an accident--in which the mood is clearly one of apprehension, tension and shock. The highly color sensitive subject would be expected to express his personally oriented color perception through the use of 'non-cultural' colors in the differentiation of these two events.

3. Actualized color perception. One would look for an openness and a playful attitude toward the coloring task at hand from the individual with a higher level of integrated color sensitivity. Colorations which are indicative of this attitude might for instance be evident from a high degree of individuating (i.e., by letting persons depicted in pictures II and IV 'speak their own color', by eliciting the colors which make particular items of vegetation in picture III 'what they really are', etc.).

4. Transactional color perception. When the color sensitive subject is exposed to the coloring task, he should show evidence that the colors have affected him to some extent. The highly sensitive subject would be expected to display signs of surprise, pleasure, displeasure, or the like during the task, whereas the less sensitive subject would be more indifferent to and unaffected by the coloring task.

Directions

The experimenter introduced the ICS test by saying: "I have

here four pictures of a variety of subjects. I am going to give you one at a time. Study each one briefly to make sure you know what is going on in the picture, and then color the picture with the felt markers in the rotating tray. You can see the colors of the felt markers on the front of the tray (he points), and you must only take the colors you are going to use from the tray. When you have finished with a marker, put it over into this tray (he points). If you want to, you can use the colors you have already used again. You'll have two minutes in which to finish each picture, so you must work fast. Do you have any questions about what to do?"

The experimenter paid special attention to behavior indicating decisiveness, hesitancy, playfulness, and to the general mood of the subject. Did the subject decide quickly on a color, or did he spend some time searching for a particular one? Did this type of task seem unfamiliar to the subject? Did the subject experiment with colors, trying out first one color and then finishing with another? Was the subject's mood indicative of enjoyment of the task or did he treat the task as a chore?

After each picture was completed, the numbers of the felt markers used were recorded.

After the entire coloring task was completed, the subject was told: "I would now like to ask you a couple of questions about what you have just been doing."

To ascertain, in part, the extent of the subject's actualized and transactional color perception, the experimenter then proceeded to ask the two following questions:

1. "Do you think you learned anything about the things and people in the pictures while you were coloring them?"

2. "How did you like doing the coloring?"

The answers to these questions were tape recorded and subsequently typewritten.

Test administration

The coloring task was administered immediately after the color discrimination test, using similar neutral gray booth and daylight type fluorescent lighting.

Scoring

Each of the four dimensions of integrated color sensitivity was scored separately, and the scoring was based on one or more of the following:

1. Picture coloring task (scored by experimenter);
2. Observation of subject during coloring task (scored by experimenter);
3. Responses to post-task questions (scored by raters).

Figure 2 shows an overview of which task results were used in assessing the four dimensions.

	Picture coloring task	Experimenter observation of subject during coloring task	Responses to post-task questions
Individuating through color	X		
Personal color perception	X		
Actualized color perception		X	X
Transactional color perception		X	X

FIGURE 2 Overview indicating which of the three task results were involved with each dimension of integrated color sensitivity.

Individuating through color. Scoring of this dimension was based on the picture coloring task alone.

The number of individuations made through color by the subject was counted as the maximum number of felt markers used in pictures I, II and IV. Two scores were obtained:

1. The sum of the numbers of markers used in the three pictures was obtained. This score indicated the total number of individuations made by the subject between objects and persons.

2. The number of markers used in pictures II and IV, but which were not repeated in either of these two pictures, was used to indicate the 'uniqueness' of the event in picture II as compared to that in picture IV.

Personal color perception. Scoring of this dimension was based on the picture coloring task alone, and all four pictures were used.

The recorded numbers of the felt markers used in each of the pictures were examined together for the experimental and control samples, and a score for each marker used by the subject was arrived at by subtracting the number of times a particular marker had been used from 26 (which was the maximum number of times a marker could be used by the full sample). The score for each subject was obtained by adding up individual scores for each marker used by that subject. Thus, an individual who used a marker which had been used by everyone else would receive a score of 0 for that

marker. Had he used a marker which was used by, say, 10 other subjects, he would have received a score of 16 (26 - 10) for that marker. If these two markers were the only ones used by this particular subject, his total score on that task (out of the four tasks comprising the personal dimension) would have been 0 + 16 = 16. It can be seen that the more personal or uncommon the selection of markers, the higher an individual's score will be.

It is noted that this procedure assumed that the cultural norm for the application of colors was based solely on the responses of the total number of subjects. In other words, the 26 subjects constituted, for the present purpose, a complete 'cultural group' in itself.

Actualized color perception. Experimenter observation of the subject during task completion and four rater assessments of answers to post-task questions formed the basis for scoring of this dimension.

1. The subject's attitude was observed and scored by the experimenter on a nine point scale ranging from 'bored, dead, manipulatory' (scored as 1) to 'responsive, alive, open, playful' (scored as 9).

2. Recorded answers such as 'I think I learned quite a bit about the people in the pictures', or 'I couldn't find the colors I wanted to use', were assessed by the four raters.

Actualized color perception was defined as consisting of four distinct dimensions, and these were assessed by the raters on a semantic differential type scale of the following kind:

passive _ _ _ _ _ _ _ _ _ manipulatory

receptive _ _ _ _ _ _ _ _ _ closed

aware _ _ _ _ _ _ _ _ _ unaware

interested _ _ _ _ _ _ _ _ _ indifferent

9 8 7 6 5 4 3 2 1

The scores were averaged, since the concept of actualized color perception was defined as the composite of the above four dimensions, and a score for each subject assessed by each rater was obtained.

The reliability of the raters' scores was tested using Winer's (1962, pp. 124-132) method. The formula for the reliability coefficient was:

$$r_k = \frac{MS_{\text{between people}} - MS_{\text{res}}}{MS_{\text{between people}}},$$

and coefficients of 0.88 for the raters' pre-training scores and 0.83 for their post-training scores were obtained.

The four raters' scores were finally averaged, and a single score for each subject was arrived at.

An A-test, testing the extent of agreement between subjective

and objective assessment of actualized color perception, was afterwards carried out. The A-test is a simplified form of the more common t-test, and it is especially useful where a comparison between two matched groups is desired (McGuigan, 1968, pp. 176-178). The formula for A is:

$$A = \frac{\sum d^2}{(\sum d)^2},$$

where d is the (positive or negative) difference between individual scores of the two groups.

The A-test showed that there was no significant difference ($p > 0.05$) between the experimenter's and the raters' scores, either on the pre or the post-training assessment.

Transactional color perception. This dimension was scored by the experimenter on the basis of observation, and by the raters on the basis of verbal responses after the task.

1. The subject's transactional attitude to the coloring task was observed by the experimenter and scored on a nine point scale ranging from 'does not seem to be affected by the task at all; the colors don't seem to excite him in the least' (scored as 1) to 'he shows strong signs of surprise, pleasure, displeasure, excitement' (scored as 9).

2. Recorded answers such as 'I really liked doing that', or 'coloring doesn't really excite me' were assessed by the raters

on the semantic differential type scales below.

Transactional color perception was defined as consisting of the following four polar dimensions:

involved	_ _ _ _ _ _ _ _ _	cold
alive	_ _ _ _ _ _ _ _ _	bored
playful	_ _ _ _ _ _ _ _ _	rigid
responsive	_ _ _ _ _ _ _ _ _	dull
	9 8 7 6 5 4 3 2 1	

The same scoring procedure as that used for actualized color perception was used here, and a single score for each subject was arrived at.

Reliability coefficients for the raters' assessments were found to be 0.91 for the pre-training and 0.90 for the post-training test scores.

The A-test comparing the subjective and objective scores, however, showed that no agreement existed between these two types of assessment.

The results of testing for rater reliability and agreement between raters and experimenter will be discussed in detail in chapter VII.

III POST-TRAINING TESTS

On the day following the training session (which itself followed one day after the pre-training tests), the Farnsworth-Munsell 100-Hue test and the ICS test were again administered to the subjects.

Procedures and scoring of the post-training tests were identical to those of the pre-training tests.

IV INTEGRATED COLOR SENSITIVITY TRAINING SESSION

Description

The object of this training experiment was to provide a variety of experiences which were thought to contribute to the heightening of the individual subject's integrated color sensitivity.

The full integrated color sensitivity training course which was constructed in accordance with the conclusions reached in chapter III looked as follows:

Session A (3 hours):

1. Color meditation exercises,
2. Positive/negative color talk,
3. Assigning colors to concepts and people, and
4. Film and slide experiences.

Session B (1-1/2 hours):

5. Color meditation exercises, and
6. Self-portrait.

Figure 3 presents an overview of which of the four dimensions of integrated color sensitivity were thought to be especially affected by each of the training techniques. The six techniques (or exercises) are described briefly below, but a complete description of them is to be found in chapter III.

1. Color meditation exercises. This consisted in 'asking' particular objects how their color makes them 'what they are' (cf. chapter II), and thus individuating through color is involved. Secondly, this was thought to be a good exercise in the Taoistic method of perception since openness to objects in the colored environment would be required. Thirdly, few individuals should fail to become aware of the effects the colors meditated upon have on them.

2. Positive/negative color talk. The 'conversation' with colors was assumed to contribute to the heightening of actualized as well as transactional color perception, since both an openness toward what the other person is trying to convey through colors as well as an awareness of subtle effects induced in the participant as a result of his own color 'statements' were involved.

3. Assigning colors to concepts and people. Awareness of how

	Individuating through color	Personal color perception	Actualized color perception	Transactional color perception
Color meditation exercises	X		X	X
Positive/negative color talk			X	X
Assigning colors to concepts and people	X	X		
Film and slide experiences	X	X	X	
Self-portrait	X	X		X

FIGURE 3 Overview of which training procedures are designed to heighten which of the four dimensions of integrated color sensitivity.

slight nuances in concepts may require fine adjustments of colors to fit these assignments could be gained from this exercise. The eight Lüscher colors used are almost invariably found to be inadequate for such fine differentiations between closely related concepts and, as a result, the individual should gain a higher awareness of the problems and possibilities of individuating through color. Also, since it is often the case that different individuals pick different colors for the same concept, it should become clear to the participants how some color choices are idiosyncratic or personal and how others, perhaps given a frame of reference in the form of a particular 'shared experience', are cultural.

In another series of experiments unrelated to those described in chapter III, the writer has had participants assign colors to the other individuals in the group. Since this seems particularly related to the notion of individuating also, such a procedure was included under the present heading.

4. Film and slide experiences. The slides consisted of landscapes, flowers and paintings by Bridget Riley and Victor Vasarely, and they were all presented in focus as well as out-of-focus. Each slide was accompanied by comments and discussion about what was shown. By virtue of their unusual content, these experiences were thought to facilitate, through distortion and subsequent loss of physical outlines of objects, persons, etc., a heightened

awareness of individuating through color, personal rather than cultural color perception through an understanding of the artist's problem of the transfer of meaning on a one-to-one basis, and actualized color perception, since an openness toward the color stimuli would be required in these experiences.

To supplement the slides, and in order to enhance the effectiveness of these experiences on all four points mentioned above, a short film, 'Mahgreb' by Paul Thompson (1972), was included in this part of the program. This was a film depicting life in the Sahara Desert, shot in high contrast black and white, and later converted into color. The colors used were unusual because they completely lacked any reference to the desert scenery, and because they were a pure expression of the film-maker's idiosyncratic perceptions. It was hoped that this film would act as a facilitator in the break-down of the subjects' established color concepts.

5. Color meditation exercises. This was a repetition of (1), and it occurred twice in the program since it was felt that no noticable effects of this part would be experienced with only one exercise.

6. Self-portrait. The aim of this exercise was to specifically heighten the ability to individuate ('self-individuating' in this case) through color, to heighten personal color perception, since the way one perceives of oneself does not always coincide with the

way one is perceived of by others, and to heighten transactional color perception, since the subject becomes aware, through group feed-back, of the effects of his creative effort.

Criteria of training procedures

The following four conditions had to be met in the development of the procedures:

1. The techniques selected could not 'teach the test', i.e., they could not teach the participants to perform in specified ways in the post-training tests. This was here interpreted to mean that such terms as 'awareness' and 'sensitivity' must not be used by the experimenter during the training session, and that the nature of the previously discussed four dimensions of integrated color sensitivity in general must not be disclosed.
2. Since the writer had found that a group of between 10 and 15 members seems to be about the right size for an enterprise of this nature, the techniques chosen must be appropriate to such a group size.
3. Due to the rather lengthy pre and post-training testing of each subject, it was desirable to keep the total group training time to less than five hours. One full day consisting of two sessions with a short break for lunch was deemed sufficient.
4. The techniques selected must be specifically directed at heightening one or more of the four dimensions of integrated color

sensitivity. The previous description of the procedures presented arguments to meet this requirement but, of course, the final assessment of the success of the program will rest on the outcome of the pre and post-training testing.

Furthermore, the activities listed conformed to points 1, 2 and 3 of the above criterion: to the first through a carefully worded set of instructions and a de-emphasizing during subsequent discussion of direct references to the four dimensional definition of integrated color sensitivity; to the second and third, since all of these techniques from the writer's experience were suitable for relatively small groups and of sufficient brevity to fit within the allotted time.

Administration of experiment

It was necessary to conduct the experiment twice since it proved very difficult to obtain volunteer subjects. The first group consisted of subjects E1 to E7 and C1 to C9, the second of subjects E8 to E15 and C10 and C11. The pre and post-training testing of these groups was identical, and great care was taken in duplicating the training session procedures and material for the two separate groups.

The room used for the training sessions was approximately 18 ft. X 20 ft. in size, carpeted, equipped with comfortable chairs, and lit by a combination of overhead 'deluxe warm'

fluorescent and incandescent lights. There were no windows in the room.

Each exercise was introduced by means of a brief, formal description and, following each exercise, an informal discussion of what had occurred took place. This latter took the form of comments and questions. Since the major aim was to attempt to heighten integrated color sensitivity rather than test the effectiveness of any one technique, it was not felt to be pedagogically warranted to place any restrictions on this interchange, and no directions for it were supplied by the experimenter.

V SAMPLES USED FOR STATISTICAL ANALYSIS

On the basis of the averaged pre and post-training color discrimination test scores and age information, a number of samples were defined for statistical analysis. (The term 'full sample' refers in the following to the complete experimental and control group numbering 26 subjects.) Table I in chapter VI shows this full sample with ages, and pre and post-training color discrimination scores.

Experimental sample

This sample consisted of 10 subjects selected from the

original 15. The original 15-subject sample had in it 5 subjects who were clearly much beyond the means as far as either age or color discrimination score was concerned. The original mean age was 25.3 years, and two subjects whose ages were 37 and 42 were eliminated. The color discrimination scores of another 3 subjects on the pre-training tests were 275, 138 and 135, and on the post-training test 145, 110 and 96 respectively. The mean scores for the pre and post-training tests were 61.8 and 43.8. By eliminating these three subjects from the experimental sample, a sample of 10 subjects, 7 female and 3 male, was defined. It had a mean age of 22.6 years and mean pre and post-training color discrimination scores of 34.7 and 25.8. The subject numbers of this sample were E2, E3, E4, E5, E6, E8, E10, E12, E13 and E15.

Control sample

This became the main control sample and was arrived at by eliminating one subject from the original control group, subject C8, whose age and color discrimination score practically coincided with those of subject C7.

This sample thus consisted of 10 subjects, 7 female and 3 male, their age mean being 22.9 years, and their mean pre and post-training color discrimination scores being 32.3 and 18.0. These latter means were somewhat lower than those of the experimental sample.

The subject numbers of the control sample were C1, C2, C3, C4, C5, C6, C7, C9, C10 and C11.

Hi-E sample

This sample consisted of the 5 highest scorers in the full experimental sample on the color discrimination tests (the pre and post-training color discrimination test scores having been averaged for the purpose of this selection). Their mean (averaged) color discrimination score was 113.0, and their subject numbers were E5, E7, E11, E13 and E14.

Lo-E sample

This sample consisted of the 5 lowest scorers in the full experimental sample on the averaged color discrimination tests. Their mean score was 16.6, and their numbers were E2, E4, E6, E8 and E10.

Hi-C sample

This sample consisted of the 5 highest scorers in the full control sample on the averaged color discrimination tests. Their mean score was 36.8, and their subject numbers were C3, C4, C5, C7 and C11.

Lo-C sample

This sample consisted of the 5 lowest scorers in the full control sample on the averaged pre and post-training color discrimination tests. Their mean score was 14.0 and their numbers were C1, C2, C6, C8 and C9.

VI STATISTICAL ANALYSIS

In order to test the hypotheses stated in chapter IV, analyses of variance in the form of two-factor designs with repeated measures on one factor (time) were carried out. A computer program termed 'Anovar' was employed, and the model used was of the following form:

$$\text{Score} = A(I) + B(J) + C(IK) + AB(IJ) + E \ ,$$

where A was 'within groups', B was 'within time', and C (subjects) was nested within the group term A, but crossed with the time term B.

Five separate analyses using pre and post-training scores were made of each set of test results for the following samples:

1. Experimental and control samples,
2. Hi-E and Lo-E samples,
3. Hi-C and Lo-C samples,
4. Hi-E and Hi-C samples, and
5. Lo-E and Lo-E samples.

Another dimension examined was what will here be called the 'utilization' performance of each subject. This term refers to the extent to which the subject utilizes areas of the spectrum in which he has good discrimination, in preference to those in which the 100-Hue test score is high (cf. questions, chapter IV).

The pre-training utilization score was derived from the pre-training color discrimination performance, and the post-training utilization score from the post-training color discrimination score. The utilization score was arrived at by counting the number of felt markers used in a particular picture. These markers were those which did not coincide with corresponding 100-Hue test caps assigned error scores. Thus pre and post-training scores for each of the subjects were obtained using the following formula:

$$\text{Score} = \frac{\frac{a_1 \times 100}{b_1} + \frac{a_2 \times 100}{b_2} + \frac{a_3 \times 100}{b_3} + \frac{a_4 \times 100}{b_4}}{4} \Big/ c,$$

where a = number of markers in 'no-error' areas,

b = total number of markers used,

c = number of total 'no-error' areas, and

subscripts 1, 2, 3 and 4 refer to scores for pictures I, II, III and IV.

In other words, the score represents the average of the percentage

of markers used which did not coincide with error caps, divided by the number of no-error areas available.

The standard five analyses mentioned above were also applied to the computed utilization scores.

CHAPTER VI

RESULTS

The Farnsworth-Munsell 100-Hue test results

An examination of the results of the color discrimination test, shown in table I, indicated that five experimental subjects deviated from the rest of the experimental sample to a marked extent. As was mentioned in chapter V, two subjects, E1 and E9, whose ages were 42 and 37 respectively, were eliminated from the experimental sample because they deviated too greatly from the mean of the remainder of the sample (mean 25.3 and range 19 to 27). Age is an important factor in color vision performance (Lakowski, 1964), and these two subjects were clearly different from the rest of the experimental subjects.

The remaining 13 experimental subjects could therefore be regarded as reasonably homogeneous at least as far as age was concerned.

In comparing the color vision scores of the remaining 13 subjects with the norms found by Verriest (Lakowski, 1969), it was found that a further three subjects deviated to a marked extent from the remaining 10 subjects. Verriest's norms are:

TABLE I

AGES AND FARNSWORTH-MUNSELL 100-HUE TEST SCORES
OF FULL SAMPLE

Subject	Sex	Age	Pre-training 100-Hue Score	Post-training 100-Hue Score	Average of Pre and Post-training 100-Hue Score
E1	F	42	20	24	22
E2	F	21	8	4	6
E3	F	24	52	16	34
E4	F	19	46	20	33
E5	F	22	52	40	46
E6	M	27	20	20	20
E7	M	25	275	145	210
E8	F	26	0	4	2
E9	M	37	12	24	18
E10	M	23	32	12	22
E11	F	23	135	96	115
E12	M	23	39	52	45
E13	F	20	78	62	70
E14	M	26	138	110	124
E15	F	21	20	28	24
C1	F	23	12	8	10
C2	F	20	0	8	4
C3	F	20	36	12	24
C4	F	22	20	44	32
C5	F	22	60	20	40
C6	M	25	24	8	16
C7	M	26	36	16	26
C8	M	26	30	12	21
C9	M	24	23	16	19
C10	F	26	16	20	23
C11	F	21	96	28	62

Subject numbers prefixed with 'E' are experimental subjects.
Subject numbers prefixed with 'C' are control subjects.

Mean age	N	Mean score	Standard deviation	Range of scores	95th percentile
20s	145	40	31	4-162	92

The subjects E7, E11 and E14 had scores of 275, 135 and 138 respectively on the pre-training color vision test, and although the scores of E11 and E14 were within the normal range for that age group, they could not be considered anywhere close to the mean of 40.

The ten remaining experimental subjects, as a result of this elimination procedure, formed a fairly homogeneous group as far as age and color vision score were concerned. Furthermore, the essential randomness of this group was not impaired since only in regard to these two factors was the group not a random sample. Its randomness in all other respects was preserved.

Since the study was only concerned with color discrimination ability, no attention was paid to possible color vision defects. One of the subjects, however, was suspected of being color defective. E7 was thought to be a probable Deutan, but no further testing was carried out to establish this.

Both the ages and color vision scores of the control sample were found to be well within the norms mentioned above. For the sake of simplicity in analyzing the results, (i.e., by obtaining a sample of the same size as the experimental one), however, it was decided to eliminate one control subject--C8--

whose color discrimination scores were practically identical with those of C7.

ICS test results

Experimental and control samples as well as four smaller samples were compared by means of analyses of variance. The results are grouped according to which hypothesis they pertain to, and the raw scores on which they are based are shown in appendix A.

The first hypothesis was:

> the subjects who undergo the sensitivity training session will make a significantly greater number of individuations through color than the subjects who do not participate in the training.

The comparison of the combined object ('oranges') and person ('children' and 'drama') individuation between the experimental and control sample showed that, although there was no overall significant difference at the 0.05 level, there were differences between the pre and post-training scores (p between .10 and .05). An examination of the data suggests that the difference was in the higher post-training score of the experimental sample. This moved from a mean score of 14.4 to 17.2 whereas the control sample remained relatively unchanged (from 12.3 to 13.6). Color sensitivity training seemed to have been an effective factor in

the higher post-experimental score.

A similar comparison of event ('children' and 'drama') individuation showed that there was an interaction effect of group membership and sensitivity training (p between .10 and .05). Although the experimental sample mean only increased from 7.8 to 8.0, that of the control sample decreased from 7.1 to 5.3. This suggests that training may have had some effect in preventing the mean from decreasing in the case of the experimental sample.

Examining results to see whether differences existed between the high and low color discrimination samples, it was found that Hi-C subjects did better on the post-training tests of individuating between objects and persons (p between .10 and .05), and between events (p between .05 and .01) than the Lo-C subjects.

No other significant results were obtained for the testing of this dimension of integrated color sensitivity.

Summary

1. Effect of training was evident in higher post-training scores for object and person individuation of experimental sample as compared to the control sample.
2. Effect of training was evident in relatively stable event individuation of experimental sample in contrast to a decreased control sample score.

3. The Hi-C sample performed better on post-training object and person individuation test than the Lo-C sample.
4. Both Hi-C and Lo-C samples performed poorer on the post-training object and person individuation test.

The data suggests that the first hypothesis can be accepted with caution in spite of the fact that only a limited number of significant results were obtained.

The second hypothesis was:

> the subjects who undergo the sensitivity training session will show a tendency toward a more personal color perception compared to those subjects who do not participate in the training.

Four coloring tasks were assessed for the scoring of this dimension.

No significant differences were found between the experimental and control samples in any of the four tasks.

In examining the performance of the Hi-Lo samples, however, a number of differences became apparent. First, there was a significant difference (p between .10 and .05) between pre and post-training scores of the Hi-E/Hi-C samples on the 'oranges' coloring task. Both samples increased their scores by about the same amount, although the Hi-E sample scored slightly lower on both tests. This suggests that training did not have any

effect on scores for the high color discrimination sample.

Second, there was a significant difference (p between .05 and .01) between pre and post-training scores for the Hi-C/Lo-C sample on the 'children' coloring task. Furthermore, this change seems mainly due to the performance of the Lo-C sample whose score increased from 68 to 96 in contrast to that of the Hi-C sample (107 to 121). This result however, does not support the present hypothesis since neither of these samples participated in the training session.

Third, on the Hi-E/Hi-C samples' performance on the 'children' task, there was a significant interaction (p between .10 and .05) between group membership and color sensitivity training. This seemed mainly due to the performance of the Hi-C sample whose mean score increased from 107 to 121. In contrast, the Hi-E sample's score decreased slightly on the post-training test from 93 to 87. Again, this result does not support the present hypothesis.

Fourth, on the 'children' task, a similar result occurred for the Lo-E/Lo-C samples. The Lo-E sample scored much higher on the pre-test than the Lo-C one, but decreased slightly (144 to 137) in contrast to the Lo-C sample which increased its score from 68 to 96. A significant overall difference (p between .10 and .05) between the two groups was found, and it seems mainly due to the Lo-C sample's post-score. No support for the hypo-

thesis was therefore found through this particular analysis.

Fifth, on the 'landscape' coloring task, there was a significant difference (p between .10 and .05) between the Hi-C and the Lo-C samples, both on the pre and the post-training tests. The Hi-C sample decreased its score from 52 to 45 whereas the Lo-C sample increased its score from 80 to 98.

Sixth, on the 'drama' coloring task, differences (p between .10 and .05) due to pre and post-training effects, and interaction effects were found for the Hi-E/Lo-E samples. This was mainly due to the Lo-E scores which went from 95 to 156 while those of the Hi-E sample decreased slightly from 91 to 88. The interaction was evident from these changes in opposite directions. No direct inferences about the hypothesis can be made from this result. However, it is clear that while both samples scored about equally well on the pre-test, the Lo-E sample seemed to perform much better on the post-test.

Seventh, on the 'drama' task, there was found to be a difference between pre and post-training scores of the Lo-E/Lo-C samples (p between .10 and .05). This seemed mainly due to the increase from 95 to 156 of the Lo-E sample, while the Lo-C sample decreased slightly from 96 to 89. Furthermore, a significant interaction was evident (p between .05 and .01) between group membership and training. This result suggests that as far as low color discriminators are concerned, training did seem to

have some effect on the post-training scores.

Summary

1. There were no significant differences between the experimental and control samples.
2. ('oranges') Training was not reflected in the Hi-E sample's post-training scores.
3. ('children') The Hi-C sample scored as high on the post-training test as the Hi-E sample.
4. ('children') The Lo-C sample improved on the post-training score of the Hi-C sample although neither sample received any training.
5. ('children') The Hi-E sample decreased while the Hi-C sample increased its score on the post-training tests.
6. ('landscape') The Lo-C sample increased while the Lo-E sample decreased its score on the post-training tests.
7. ('drama') The Lo-C sample increased while the Hi-C sample decreased its post-training score.
8. ('drama') The Lo-E sample scored higher than the Lo-C sample on the post-training tests.

All of these finding, with the exception of no. 8, were against the hypothesis. Furthermore, no. 8 was in contradiction to no. 6. The second hypothesis therefore had to be rejected, and it was

concluded that the training provided did not produce the expected increase in post-training scores of the experimental samples.

The third hypothesis was:

> the subjects who undergo the sensitivity training session will show an increase in actualized color perception compared to those subjects who do not participate in the training.

Subjective (i.e., carried out by the experimenter) and objective (i.e., carried out by a panel of four raters) assessments were obtained.

Subjective results

No significant differences between the experimental and the control samples were found.

In examining the results of the Hi-E/Lo-E scores, which was the only analysis yielding significant results, it was seen that a significant change (p between .10 and .05) had occurred as a result of the training. Both of these samples increased their scores about equally (from 3.7 to 4.7 and 4.2 to 5.0, respectively).

Objective results

A significant difference (p between .05 and .01) as a result of training was found between the experimental and the

control sample. Although both samples increased their scores from pre to post-test, the control sample's increase was relatively small (4.6 to 5.1) compared with that of the experimental sample (3.8 to 5.5). This data suggests that the difference was mainly due to the post-training performance of the experimental sample, and that training thus seems to have been an effective factor.

The results of the other samples' scores showed that for the Hi-E/Lo-E samples, a significant difference ($p < .01$) occurred from the pre to post-training test, but that both of these samples performed about equally well. There was furthermore no substantive difference between the two samples on either pre or post-training test. The data here suggests that a decisive effect of training was evident in both of these post scores.

Analysis of the Hi-E/Hi-C samples showed a significant difference (p between .05 and .01), largely accounted for by the increased Hi-E scores (from 3.6 to 5.9) as compared to the slight Hi-C increase (from 4.9 to 5.2) Also evident was an interaction effect of group membership and training (p between .10 and .05), which mainly seemed due to the Hi-E increase. This data suggests that the significant change which occurred in the case of the Hi-E sample was a result of the effects of training.

The Lo-E sample did not perform quite this well on the

post-training test as compared to the Lo-C sample, although a significant overall change (p between .05 and .01) from pre to post-testing seemed mainly due to the Lo-E increase (from 3.5 to 6.0). However, the Lo-C sample also increased (from 3.8 to 4.5), and it is questionable whether a clearcut statement can be made about the effects of training in this case.

Summary

Subjective results

1. There were no significant differences between the experimental and control samples.
2. Both Hi-E and Lo-E samples increased their post-training test scores.

Objective results

3. The experimental sample scored significantly higher on the post-training test than the control sample.
4. Both the Hi-E and Lo-E samples increased on the post-training test.
5. The Hi-E sample showed a significant increase in score over that of the Hi-C sample.
6. The Lo-E sample may have performed slightly better than the Lo-C sample on the post-training test.

From these findings, it is apparent that the third hypothesis

can be accepted.

The fourth hypothesis was:

> the subjects who undergo the sensitivity training session will show an increase in transactional color perception compared to those subjects who do not participate in the training.

In a manner similar to that employed in the assessment of actualized color perception, this dimension of integrated color sensitivity was also assessed by both the experimenter and the four raters.

Subjective results

There were no significant differences found between the experimental and the control samples.

Analysis of the Hi-E/Lo-E sample scores, however, showed a significant interaction between group membership and training (p between .10 and .05). In this case, the Hi-E sample increased its post-training score from 3.4 to 4.7, while the Lo-E sample decreased its score from 5.5 to 4.2. The positive effect of training in the case of the Hi-E sample seems therefore to be suggested by this data.

Results of the comparison between the Hi-E and the Hi-C mean scores showed an even more decisive increase in post-training test Hi-E scores. An interaction which seemed attribu-

table largely to the post-training test Hi-E scores was present (p between .05 and .01). This latter sample went from a mean score of 3.4 to 4.7, while the Hi-C sample decreased its score from 3.9 to 3.1. The effect of training, therefore, on the Hi-E sample is strongly suggested by the data.

The Lo-E sample did not score as high as the Lo-C sample. Both samples however increased their scores slightly. No conclusion can be drawn as to the effect of training, since a significant difference was only evident between groups (p between .10 and .05).

Objective results

The comparison of transactional color perception between the experimental and the control sample showed that there was a marked interaction between the effects of group membership and training (p between .05 and .01). The data suggests that this result was due mainly to the increased post-training score of the experimental sample (from 4.1 to 6.3) as compared to the decreased post-training score of the control sample (from 5.4 to 4.9). Training thus seemed to be a factor of significance although no significant result was found for training only over the two samples. It was furthermore interesting to note how the experimental sample scored considerably lower on the pre-training test than the control sample, and how this was markedly

reversed in the post-training test scores.

A highly significant difference ($p < .01$) was found between samples Hi-E and Lo-E, as well as between their pre and post-training scores ($p < .01$). The Hi-E sample scored much lower on the pre-training test than the Lo-E sample (2.9 versus 5.8), but on the post-training test the mean scores were 6.2 for the Hi-E sample and 6.9 for the Lo-E sample. Training seems here to have been especially effective in the case of the Hi-E sample.

The comparison between the Hi-E and Hi-C samples showed a significant difference (p between .10 and .05) between pre and post-training scores, as well as an interaction between effects of group membership and training (p between .05 and .01). The Hi-E sample's pre-training test mean score was 2.9 (as compared to 5.3 for the Hi-C sample), and that of the Hi-E sample's post-training test score 5.3 as compared to 5.1 for the Hi-C sample. With the significant change therefore reflected in the Hi-E sample's post-training score, it must be assumed that this interaction stems primarily from the noticable effect of training.

The Lo-E sample also did rather well on the post-training test as compared with the Lo-C sample. Its mean score increased from 5.8 to 6.9 whereas that of the Lo-C sample decreased from 5.0 to 3.9. There was a resultant significant difference between the samples (p between .05 and .01) as well as an inter-

action between group membership and training (p between .10 and .05). Training seems to have been a factor in the occurrence of these significant differences.

Summary

Subjective results

1. There were no significant differences between the experimental and control samples.
2. The Hi-E sample scored significantly higher on the post-training tests than the Lo-E sample.
3. The Hi-E sample scored significantly higher on the post-training tests than the Hi-C samples.

Objective results

4. The experimental sample scored significantly higher on the post-training tests than the control sample.
5. The Hi-E sample scored significantly higher on the post-training tests than the Lo-E sample, although both of these samples increased their post-training test scores.
6. The Hi-E sample scored significantly higher on the post-training tests than the Hi-C sample.
7. The Lo-E sample scored significantly higher on the post-training tests than the Lo-C sample.

These findings support the fourth hypothesis.

Utilization score results

Analyses of variances were carried out, but no results of significance were obtained.

CHAPTER VII

DISCUSSION

Introduction

The present study was experimental in the fullest sense of the word in that it not only attempted to measure behavior in an experimental setting, but did this on the basis of its own theory and, to some extent, its own methods of measurement.

The concept under investigation was integrated color sensitivity. Once the basic theory supporting the explication of this concept had been developed, a set of operational definitions were laid down. These, subsequently, became the basis for the four hypotheses and the research questions. A condensed color sensitivity training course was patterned on the casual methods and results of a number of pilot studies involving color sensitivity training, and this short course was used to test the general thesis that integrated color sensitivity can be heightened.

The existence of the concept of integrated color sensitivity was taken for granted--at least while the theory was being developed--although the subsequent occurrence of a number of significant results confirmed that a concept like that described exists. Whether the concept, as a result of the experimental findings, needs revision is another question, and one

which will be discussed later in this chapter.

The effectiveness of the measures and training techniques used were also subject to testing, although only the latter were specifically subjected to testing. The success--or lack of success--of the ICS test itself emerges only indirectly as a result of the testing.

The possibility that something may go seriously wrong in an experimental study of this kind was particularly great since so many of the procedures were new and untried, and since there always was the risk of misinterpreting the test results in such a way that one step of the process from theory to results got blamed for failures which in fact were incurred by another. This problem was further compounded by the fact that, although extensive enough for the stated purpose, the tests did not apply themselves to detecting the specific origin of failure, and by the fact that a quite small number of subjects were used for the experiments (N = 10 and 5). While these small samples were of sufficient size to gain a broad picture of the problems, they of course were not large enough to yield results of great statistical reliability. It should therefore be remembered that the interpretation of the results does not intend to state in unequivocal terms that these results will be found whenever the tests are conducted. Rather, the interpretation means to point out ways in which the theory, the hypotheses, the measurement methods

and the training techniques might be improved or restated, and to indicate in a general way what might be expected in experiments of this nature.

For the purpose of the experiments, four specific hypotheses and a number of questions were investigated. The results showed that the third and fourth hypotheses were confirmed, that the first could be confirmed with caution, and that the second had to be rejected.

The first hypothesis

This hypothesis was accepted with caution since, although the comparison of the combined object and person individuation for the experimental and control samples showed a significant change due to the effects of color sensitivity training, the results of the event individuation showed that the experimental sample did not increase its post-training mean score while the control sample, on the other hand, decreased its score.

The reasons for this may be several. First, it is noted that this was the only significant result on the event individuation task. Comparisons involving the Hi-E, Lo-E, Hi-C and Lo-C samples did not yield any significant results. This fact in itself would seem to cast doubt on the event part of the hypothesis.

Secondly, the experimental and the control samples might

have had certain inherent characteristics which the experiment was not designed to test for, and about whose effect on the results one can only speculate. However, had these hidden variables existed, the results of the two samples' performance on the actualization and transactional dimensions would likely have confirmed this. As the results turned out, it appeared that the two samples behaved as expected. There was no reason to suspect that effects which did not show up in the testing of these two dimensions would manifest themselves only on that of event individuation, and it must therefore be assumed that no hidden effects existed.

Thirdly, the claim that color sensitivity training will result in higher post-training experimental scores on the event individuation task may simply be mistaken. The scores were derived from a count of the markers used, and it is possible that the number used on the post-response may in fact decrease while the quality of the response increases. That is, it stands to reason that a subject who only uses, say, two markers in the two minute time period allotted will spend much more time coloring with these two markers than a subject who uses ten markers in the same length of time. Some such notion as the quality of individuation may have to be included and tested for in experiments designed to follow up this particular problem. A good case in point was the performance of subject E10 who on the

post-training test only used two colors for the 'drama' coloring task. The experimenter's comments seem typical of the qualitative aspect just mentioned: "Just sits and looks at last picture. Rotates tray. Tries to pick color. Picks one. Not certain of it. Picks green. Works fast now." This subject seemed less concerned with covering the picture with color or with using as many colors as possible in the two minute period as he seemed with using the colors which most appropriately expressed the way he felt about the picture.

Finally, it might be argued that the two parts of the test (i.e., the combined object and person, and the event parts) were quite different, both in conception and in method of scoring. That is, it might reasonably be said that the first hypothesis really ought to have been formulated as a two-part hypothesis, and that the first part--judging from the available results--was in fact confirmed. Had there been a second part, it would then not have been confirmed.

The event part of the first hypothesis was concerned with how unique the two pictures assessed were, and the scores were obtained by counting felt markers used and subtracting those which had been repeated in either of the two pictures. This procedure was in principle similar to that used for the assessment of the personal color perception dimension except that the 'cultural' was defined wholly in terms of the individual's

responses to the two pictures rather than in terms of the total group performance, and only completely unique responses received a score. The present method thus resembles those associated with the second hypothesis--a hypothesis which could not be confirmed at all--and some of the possible reasons for the latter's rejection may equally well account for the non-confirmation of the present event individuation part of the first hypothesis.

The second hypothesis

Color sensitivity training definitely did not seem to have any effect on the personal color perception post-training scores. Was this due to faulty theory, poor methods of measuring performance, or inadequate training?

While the theoretical framework for the inclusion of the specially defined notion of creativity in integrated color sensitivity (cf. chapter II) seems solid enough, the concept of personal color perception, as one instance of creative color perception, may be of questionable merit. However, this concept seemed sufficiently justified in the theoretical discussion.

The scoring system--awarding higher scores to the less frequently repeated responses--was similar in principle to that used by Torrance (1966) in his assessment of the originality, flexibility, fluency and elaboration dimensions of creativity.

It was therefore assumed that this method of scoring was adequate for the purpose at hand.

One reason for the perplexing result may be that the test itself did not afford the subject with enough scope for showing his personal orientation in choosing colors. Many subjects commented upon the lack of particular colored felt markers, and a much finer test instrument, which truly gives the individual the opportunity to use the colors he wishes to use instead of the limited range of 29 hues and no value or chroma variations might be required.

The 'culture' from which the norms were elicited (N = 26) was also rather small, and perhaps a much larger sample, say between 200 and 300 subjects, would have made possible the determination of a more accurate cultural norm. Perhaps compared to this, individual creative responses would have been easier to detect.

It was mentioned in chapter II how existing color paradigms may not be adequate for the characterization of creativity in color perception since, by definition, the creative involves what is beyond that already known or perceived of. In spite of the fact that a larger sample and a finer test may be used, therefore, the attempt to assess the true creative aspect of personal color perception may be doomed from the start unless the test can be constructed in such a way as to measure what at

present is non-measurable. Kuhn (1962) and Toulmin (1961), for instance, speak extensively about new paradigms and scientific creativity, and if a parallel is drawn between their exposition of the development of a creative scientific model and the present method of measuring creative color perception, it becomes apparent that the only feasible way to gain a glimpse of the unknown is to come to know the known as thoroughly as possible, and then proceed to examine slight inconsistencies which may result from inexplicable predictions. The present examination of personal color perception can be seen as the first small step toward the goal of knowing more about the known.

Yet another reason for the non-confirmation of the second hypothesis may be that the training procedures were ineffective insofar as the personal dimension was concerned. However, both through the materials used, and during the group discussions stress was placed on the notion of creativity and how different objects have their own unique coloration. The coverage of this dimension in the training session seems to have been as good as that of the other dimensions for which satisfactory results were obtained.

Finally, it could be the case that the ability or attitude associated with this particular dimension of integrated color sensitivity takes a longer time to be acquired than the other three. That is, it may take more time (with or without consistent

training) to break out of the established cultural color paradigm than it takes to learn to appreciate or enjoy the coloring task or acquire a playful or open attitude toward it. Further experiments will have to test this latter suggestion.

The third hypothesis

The dimensions of actualized and transactional color perception were initially thought to be the two most difficult dimensions of integrated color sensitivity to measure since they depended less on numerical counts of responses than on assessments according to fairly complex criteria, both by the (subjective) experimenter and the (objective) raters. It was therefore particularly gratifying to find that so many significant results were obtained on these two dimensions.

Experimental subjects clearly performed better than control subjects on the actualization dimension, and this was also confirmed by the performance of the Hi-E and Lo-E samples, whose mean scores were significantly higher than those of the Hi-C and Lo-C samples respectively. Color sensitivity training, therefore, seems to have been the effective factor accounting for the significant changes.

It is interesting to note that with the exception of the Hi-C mean score there were only slight differences between the pre-training scores of the four samples: Hi-E, Hi-C, Lo-E and

Lo-C (3.6, 4.9, 3.5 and 3.8 respectively). The 4.9 mean score of the Hi-C sample was somewhat out of line with the others in that it was higher. This discrepancy may have been due to the small size of the sample, or it may have been due to the particularly low mean color discrimination score of this sample (36.8) as compared to the Hi-E sample (113.0). Although it was generally assumed that all subjects started out with the same capacity for learning and for perceiving, the most likely answer may be that this particular sample did in fact start out with a higher mean level of actualized color perception than the three other samples. This result might not have occurred had the samples been larger and thus more randomly representative.

The fourth hypothesis

The hypothesis claiming that transactional color perception would be heightened as a result of color sensitivity training was confirmed. The results showed that the experimental subjects consistently performed better than the control subjects and that furthermore the Hi-E and Lo-E samples did better than the Hi-C and Lo-C samples, respectively.

On the pre-training test, the mean scores for the Hi-C, Lo-E and Lo-C samples were about the same (5.3, 5.8 and 5.0 respectively), whereas that of the Hi-E sample was considerably lower viz., 2.9. This is interesting for two reasons. First, because

it may confirm the point made above that it is difficult to predict how such a small sample will score and secondly, this particularly low pre-training score contributed to the overall rather low pre-training score of the experimental sample (4.1) as compared to the control sample (5.4).

Utilization results

It was disappointing not to find any significant results from the analysis of utilization scores, since it was hoped that the subjects' color discrimination ability somehow might provide an index to how they would perform on the ICS test. From the outset, it did not seem unreasonable to assume that a subject's physiological color discrimination ability would be reflected in his ability to become more aware of colors and that, as a result, a correlation between his color discrimination ability and his integrated color sensitivity might exist. The results, however, clearly showed that no such correlation existed.

One reason for this may be that the scoring procedure did not adequately characterize the subjects' performance. In order to review the scoring procedure, several steps must be examined. First, for each coloring task, a percentage which expressed the number of markers used which coincided with 100-Hue test caps carrying no error score versus the total number of markers used was worked out. The resultant figure expressed the degree of

overlap between markers used and corresponding 100-Hue caps: the higher the percentage, the less overlap there was, i.e., the more use there was of no-error areas. Taken by itself, this figure was biased against the high color discrimination scorers since these subjects would have so many fewer areas of no-error than the low scorers, and they would thus in some cases simply not be able to fit their total selection into the small no-error areas. Low scorers, on the other hand, would not encounter this problem since almost any marker they chose would be certain to coincide with a no-error 100 Hue cap. In order to adjust for this bias, further adjustments which will be mentioned momentarily were made.

Secondly, since reliability and validity were of prime concern, the percentage scores for all four picture coloring tasks were averaged. Although it perhaps could be argued that it was unreasonable to expect utilization to manifest itself equally on such diverse tasks as those employed, and that the individual task scores in fact might show subject specificity, it was thought that, since the criterion of excellence was the same for all tasks, a combined score was justified.

Thirdly, in order to overcome the above mentioned bias, the averaged percentage score was divided by the total number of no-error areas available. This was done to make it a function of what was possible for a particular subject to achieve.

It was thought that this procedure would give the high scorers--who in many cases had perfect 100-Hue scores in parts of the spectrum--a chance to obtain high percentage scores in spite of their localized color discrimination handicap. That is, the 'good' areas used would be credited with points as if there were no areas of poor color discrimination throughout the remainder of the spectrum.

The scoring procedures, which in this case are fairly involved, are a determining factor in how the concept of utilization is interpreted since they form the practical criterion for what counts as utilization. By virtue of this, it does not seem possible to criticize the scoring method as being wrong as long as some degree of agreement exists between the definition of the concept and its practical criterion, and no gross inconsistencies between the two exist. On reviewing the concept and its measurement, it seems that both of these conditions have been met.

Another characteristic of the test which could possibly account for the lack of significant results might be that the colors of the 29 felt markers employed did not correspond precisely enough to the corresponding 29 100-Hue test caps. This might be due to the material properties of the colors: size of pigment particles may vary, as may the medium base into which they are ground, to the fact that felt markers after even slight use tend to get lighter and less saturated, and to the peculiar

properties of the Xerox paper used in the coloring task. This paper, with its fused toner-particle surface, did seem to introduce variations in the applied colors which made them slightly different from the original color samples on which the colorimetric measurements were based.

The resultant effect due to one or more of these points might have been such that factors other than hue discrimination determined the choice of colors used and that, in consequence, the fine nuances which the 100-Hue test detected were lost in the subsequent coloring task. If this indeed was the case, it is not surprising that high color discrimination scorers (i.e., poor color discriminators) performed as well on utilization as the low scorers.

The high scorers furthermore might have had an unduly easy task due to the spacing of the 29 felt markers around the spectrum. It might have been too easy even for poor discriminators to distinguish between felt marker colors since they were not nearly as closely spaced as the 85 100-Hue colors. This would tend to lose the purpose of fine color discrimination which the 100-Hue test established and thus result in lack of differences between high and low color discrimination scorers.

Should one have expected a significant change on the utilization scores as a result of color sensitivity training? For one thing, it was known that 100-Hue test scores as a rule would

decrease on re-test and, since the pre-training utilization scores were based on the first 100-Hue scores and the post-training utilization scores on the 100-Hue re-test scores, it seemed reasonable to expect an improvement in utilization on the post-test. For another thing, improvement could be expected since the color sensitivity training did focus on the aspect of awareness of colors. Whereas the pre-training utilization scores might thus have reflected rather mindless and haphazard choices, the post-training scores should have been indicative of a more attentive and color conscious attitude.

Briefly comparing the results of the other ICS test tasks, it is interesting to note that only four instances of significant differences between high and low color discrimination scorers occurred. These were on the combined object and person individuation dimension where it was found that the Hi-C sample performed better on the post-training test than the Lo-C sample, on the 'children' task of the personal perception dimension where the Lo-C sample improved more than the Hi-C sample on the post-training test, and on the transactional dimension, both according to the subjective and objective ratings, where the Hi-E sample did better than the Lo-E sample on the post-training test.

These instances, however, are not sufficient to establish that any difference between high and low scorers really occurred as a result of the sensitivity training, especially since the low

control sample did better than the high control sample in the second instance whereas, in the other instances, the high scorers did better than the low scorers.

Finally, a word should be said about the concept of utilization itself. Initially it seemed reasonable to assume that physiological color discrimination ability should in some way affect performance on the ICS test since the latter did concern itself with the perception of colors. The lack of significant results now raises the possibility that this assumption may be unwarranted. Is it possible that the type of internalization which the ICS test professes to measure in fact is not specifically color oriented, but rather pertains to the acquisition of some abstracted units of reality (in the present case, color), and that the capability which is necessary for this acquisition perhaps resembles intelligence more than color discrimination? One way to get answeres to this question might be to conduct further experiments, but while it may turn out to be true, it could still be the case that color discrimination is an effective factor in ICS test performance. For example, some of the possible sources of inadequacy relating to the utilization results mentioned may, if corrected in further experiments, show that a threshold level of color discrimination proficiency is needed for a particular level of integrated color sensitivity to establish itself or for a heightening of it to occur, just

as some sort of minimum visual capability seems required in order to develop any consciousness which has as its basis visual sensory input.

Problem of training

It was pointed out in the last chapter that one reason for the lack of significant results on the event individuation dimension might have been that more time is required to break old or existing paradigms. This introduces the problem of time spent on the sensitivity training, and it raises the question of whether in fact 4-1/2 hours was enough time to attain the goals aimed for. If only the acquisition of a skill had been the purpose of the training, this time might have been sufficient. Considering however that a process of internalization was required, one wonders if 4-1/2 hours really was sufficient time. To thoroughly make some concept part of one's conceptual framework may take days or months instead of hours, and it might not have been surprising after all that many of the results lacked significance. At the same time, it would then be even more surprising that two out of four hypotheses were so strongly confirmed. An argument for this position would be that, while learning generally does take a good deal of time to 'sink in', it may only take a momentary revelation (perhaps during a peak or near-peak experience) to shake up the conceptual framework and start the assembly of a new one.

Consequently, internalization would proceed in distinct leaps, and it may just so happen that the color sensitivity training provided a condition for such leaps. Whether in fact this was the case is impossible to discern from the present results, and further experiments which specifically explore this would have to be conducted.

Another two reasons for the color sensitivity training not having the desired effect in all cases may be the following. First, it was decided that the training should not teach the ICS test to the subjects (cf. chapter V). This was interpreted to mean that terms such as 'awareness' and 'sensitivity' should not be used in the training sessions. Better results would possibly have been obtained had the subjects been told the full facts about the ICS test, and been put through specific exercises which prepared them for performance on it. In part, then, the test taking skill would have been developed, and in part the subjects might have been provided with a stronger motivation for performing well on the post-training ICS test. However, seen in retrospect, the restraint placed on the training procedures make the partially successful results even more convincing. An interesting and valuable series of experiments could be conducted in which different degrees of disclosure of information about the concept of integrated color sensitivity constituted the difference between experimental samples.

Secondly, the possibility exists that the training was successful, but that the post-training results really were a function of test-taking habits rather than of training. This possibility is a two-edged sword in the sense that positive results (perhaps most evident in the case of the control samples) may have been a result of learning acquired during the pre-training testing, and negative results a result of the above mentioned time factor in combination with the test-taking habit developed during the pre-training testing. However, it may also be the case that these various factors cancel each other out since they probably affect experimental and control samples alike. Again, further experiments would have to clarify this point.

Finally, it must be asked whether in fact the experimenter's presence or simply the time he spent with the subjects during the training session rather than the training itself accounted for the difference between experimental and control scores, especially on the actualized and transactional dimensions. These two dimensions possibly involved more of a change in subject attitude than the other two, and it is quite probable that the enthusiasm and zeal of the experimenter to a large extent accounted for the higher post-training experimental scores. However, there seems no reason why the qualities of the experimenter should not be considered a legitimate part of the training situation although it may indeed be the case that another teacher

will obtain different results. Just as the precise effects of each training technique were not tested (only the gross effects of the combined techniques were tested on the four dimensions of integrated color sensitivity), so the effects of the experimenter need not be specified. At the same time, this does not mean that further experiments using different teachers will not contribute interesting information about the experimenter as a variable.

A more serious problem is that of time spent during the training session with the experimental subjects as compared to the lack of time spent with the control subjects. Was it the time spent with the experimental subjects rather than content of training session or personality of the experimenter which made the post-training difference in scores? The most likely answer in support of the training being the effective factor is that the content of the training techniques used was both quite specific and complex. That is, the techniques were designed to convey particular information, and they had been refined and condensed from the much lengthier pilot projects to such an extent that, in order to contain the desired information, their construction had to be highly complex. It is argued that anything less than what was presented would not have effected the results obtained.

Furthermore, two hypotheses were confirmed and one was partially confirmed. Had the time and experimenter variables been effective, one would have expected all four hypotheses to

have been confirmed.

Raters' reliability and comparison between raters' and experimenter's scores

As mentioned in chapter V, coefficients for the raters' reliability were worked out. These were quite high, and in chapter VI the extent of this agreement between raters' scores was relied upon to confirm the third and fourth hypotheses.

In addition, A-tests, testing the extent of agreement between raters' and experimenter's scores, were worked out. As mentioned in chapter V, these showed that there was no difference on the actualized dimension, and that there was no agreement on the transactional dimension.

The results of the A-tests raises the question of whether the subjective or the objective results are the more reliable. Considering that the two types of assessment were based on different things--the experimenter's on direct observation of the subject during the picture coloring task, the raters' on the transcribed answers to post-task questions--it is perhaps not surprising that only agreement on one dimension occurred. It might in fact be surprising that agreement did occur at all. However, since the same concepts (i.e., those of actualized and transactional color perception) formed the criteria for both the raters' and the experimenter's assessments, it might be

expected that at least some agreement would manifest itself.

In deciding to rely more on the raters' assessments than on the experimenter's, several points were considered. The raters' assessment was the more objective of the two due to its more detailed nature (i.e., four facets of each dimension were assessed on the semantic differential scale), four raters were used as compared to only one experimenter, there was substantial agreement between the raters, and the experimenter might have had difficulties in avoiding a bias toward obtaining 'good' results whereas the raters were not aware of which subjects were experimental or control subjects, or which results were pre or post-training results.

The A-tests which were carried out with the pre and post-training actualized scores seem to lend special credibility to the third hypothesis. Point no 4 (numbers refer to those used in reporting results in chapter VI) is supported by point no 2, and together with points 3 and 5 form a reasonable basis for the acceptance of the hypothesis. The slightly inconclusive evidence furnished by point no. 6 does not seem to outweigh the supporting evidence of points 2 to 5.

Since the raters' and the experimenter's assessments of transactional color perception agreed, this is interpreted to indicate an even stronger support for the fourth hypothesis than if only the raters' assessments had resulted in these

positive results.

Problem of validating the ICS test

Although it was not the purpose of the experiment to validate the ICS test, the question still remains as to whether the ICS test really measures what it professes to measure, and with what degree of confidence one can expect the same results on subsequent testing. Without data, this problem at best makes the results obtained tentative. Experiments could be constructed which compare specific parts such as actualized color perception of the ICS test to established tests such as the Shostrom Inventory (Shostrom, 1964) although the latter really is a personality test and the media specificity which characterizes the ICS test would be lacking. As far as the other dimensions of integrated color sensitivity are concerned, there do not seem to be any tests which are directly comparable. Much more theoretical groundwork would also be required before such comparisons could be made. The simplest and perhaps the most reliable way of assessing the ICS test would be to assess the results in real life situations. In chapter I it was mentioned that some individuals seem to be more color conscious than others, and that artists in particular were good examples of this type of individual. A study which for instance compares the ICS results to actual day-to-day performance of artists may provide the most

direct and reliable way of validating the ICS test.

Problem of small samples

It has been mentioned on several occasions above how the small number of subjects may have contributed to the lack of significant results in some cases. This may in particular be true in the case of personal color perception since the occurrence of the type of creative subject in question may indeed be very rare. While conducting the pilot projects in color sensitivity training, the writer had contact with approximately 500 individuals and, as a rough estimate, perhaps only 10 or 15 of these appeared to display any sort of creative attitude as a result of the training. This makes the number of individuals who could be expected to heighten their personal color perception less than 3%. Since the largest statistical sample used in the present study was 10, it seems highly unlikely that even one subject should exhibit this unusual change. The ICS test, then, was searching for the unusual, and in many cases failed to find it. Even if one such subject had been found--and there is some question of whether subject E4 was such a person since she scored consistently higher on the post-training personal dimension on all four tasks (176 to 327, 182 to 227, 102 to 174 and 132 to 281)--his positive score would have been lost in the statistical analysis. Much larger samples would therefore be needed to detect these

unique individuals, or real life situations as described above might provide further experiments with subjects who have a greater than average probability of displaying a heightened integrated color sensitivity.

Conclusion

The present study endeavored to take a small part of reality and to explore it as widely and thoroughly as possible. A myriad of questions and puzzles have been generated as a result of the relatively few initial questions posed, and in some way less seems to be known about integrated color sensitivity now than at the outset. However, it is probably in the nature of any investigation in a new area that more questions are created than are answered, and that the few answers which do emerge only appear so much less substantial in comparison to what the study shows it is possible to know.

The results were encouraging and indeed surpassed the expectations of the experimenter. Two hypotheses were confirmed, one was partially confirmed, and another was rejected. However, the exploration of even the rejected hypothesis provided so much insight into the topic at hand--perhaps even more than the accepted ones--that its formulation was well worthwhile.

One of the important outcomes of the study was that color sensitivity can be heightened by deliberate training. The pros-

pects this affords for teaching seem endless. Certainly it would seem to be the case that the teaching of color sensitivity is of greater relevance to the education of a person than many of the make-work activities which now predominate in many 'art' classes.

Perhaps the single most important fact learned from the study was that the concept of integrated color sensitivity does indeed exist, and that it is possible to investigate it and learn more about it. Nothing in the results leads to the conclusion that the concept should be abandoned. On the contrary, every indication is that the further study of it will produce valuable insights into how man perceives of and responds to his color environment, that some level of understanding of this transaction will emerge, and that man eventually, as a result, may become less a victim and more a creator of the color environment he really desires.

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APPENDIX A

RAW SCORES

TABLE A1

PRE AND POST-TRAINING INDIVIDUATIONS
EXPERIMENTAL AND CONTROL
SAMPLE SCORES

	Pre-Training Individuations		Post-Training Individuations	
Subject	Object/Person	Event	Object/Person	Event
E1	22	11	22	9
E2	17	9	21	8
E3	12	8	13	9
E4	22	10	39	14
E5	15	10	17	8
E6	23	12	18	5
E7	9	4	14	6
E8	10	5	11	6
E9	14	7	15	12
E10	10	6	8	6
E11	19	8	18	8
E12	9	7	9	3
E13	11	6	8	7
E14	5	4	4	3
E15	14	10	11	5
C1	13	8	11	8
C2	9	5	11	4
C3	8	8	13	8
C4	10	8	9	6
C5	19	10	25	6
C6	11	4	12	2
C7	12	7	18	7
C8	13	9	14	8
C9	10	5	10	1
C10	22	11	19	6
C11	9	5	8	5

TABLE A2

PRE AND POST-TRAINING
PERSONAL COLOR PERCEPTION SCORES -
EXPERIMENTAL AND CONTROL SAMPLE

Subject	Pre-Training 'Oranges'	Post-Training 'Oranges'	Pre-Training 'Children'	Post-Training 'Children'	Pre-Training 'Landscape'	Post-Training 'Landscape'	Pre-Training 'Drama'	Post-Training 'Drama'
E1	144	96	146	181	97	156	172	157
E2	34	49	154	156	112	48	145	204
E3	42	68	105	100	58	89	108	120
E4	176	327	182	227	102	174	132	281
E5	72	98	85	100	77	109	106	141
E6	122	95	216	140	69	109	122	166
E7	62	136	73	72	89	62	78	107
E8	48	52	50	81	81	57	76	83
E9	93	47	85	127	61	101	73	110
E10	62	32	119	80	41	57	0	46
E11	58	117	150	139	116	100	157	112
E12	51	45	53	62	37	58	79	79
E13	40	18	110	81	55	21	65	64
E14	10	11	45	42	57	24	48	16
E15	62	38	102	109	76	58	101	77
C1	42	95	85	100	83	98	116	63
C2	62	76	32	65	47	95	56	102
C3	18	59	104	99	72	60	60	116
C4	75	35	80	103	29	30	89	63
C5	164	243	119	159	52	36	90	148
C6	104	81	59	97	86	81	57	52
C7	16	105	155	167	86	73	69	178
C8	62	109	101	148	88	138	147	143
C9	78	74	64	70	97	78	106	87
C10	117	103	178	179	131	147	182	95
C11	26	11	75	78	19	26	58	56

TABLE A3

PRE AND POST-TRAINING
ACTUALIZED AND TRANSACTIONAL
COLOR PERCEPTION
SUBJECTIVE AND OBJECTIVE SCORES

	Subjective				Objective			
Subject	Pre-Training Transactional	Post-Training Transactional	Pre-Training Actualized	Post-Training Actualized	Pre-Training Transactional	Post-Training Transactional	Pre-Training Actualized	Post-Training Actualized
E1	6.3	7.7	9.0	9.0	8.88	5.44	5.88	3.25
E2	6.3	6.3	7.7	6.3	6.56	5.50	4.19	3.63
E3	1.0	5.0	2.3	3.7	1.88	4.81	1.75	4.44
E4	2.3	7.7	2.3	6.3	3.63	7.88	2.25	7.13
E5	3.7	5.0	5.0	6.3	2.56	8.25	2.13	7.88
E6	6.3	6.3	6.3	7.7	5.25	7.19	3.50	6.44
E7	3.7	6.3	5.0	6.3	2.00	5.50	3.63	5.75
E8	3.7	3.7	2.3	2.3	6.19	6.75	3.56	6.31
E9	2.3	3.7	2.3	2.3	5.44	7.00	6.56	6.50
E10	6.3	3.7	2.3	2.3	7.25	7.31	4.19	5.94
E11	5.0	6.3	5.0	6.3	3.56	5.69	5.00	6.31
E12	2.3	5.0	1.0	2.3	2.19	8.19	3.44	6.56
E13	3.7	3.7	2.3	2.3	1.56	6.56	4.13	5.81
E14	1.0	2.3	1.0	2.3	4.63	5.00	3.25	3.94
E15	3.7	3.7	3.7	3.7	7.19	5.63	5.25	5.81
C1	5.0	6.3	6.3	6.3	4.00	3.81	2.56	3.69
C2	1.0	3.7	2.3	5.0	3.75	2.75	3.44	4.50
C3	2.3	2.3	2.3	3.7	6.13	5.19	5.00	5.13
C4	3.7	3.7	3.7	3.7	6.94	5.44	3.88	5.38
C5	6.3	3.7	6.3	6.3	5.00	7.63	5.63	6.81
C6	3.7	2.3	6.3	1.0	5.13	5.06	3.25	5.88
C7	5.0	3.7	6.3	3.7	5.13	2.13	5.25	3.50
C8	3.7	6.3	5.0	6.3	5.50	1.88	4.06	3.06
C9	2.3	2.3	2.3	3.7	6.63	6.13	5.63	5.44
C10	3.7	5.0	6.3	6.3	7.50	5.38	6.25	5.88
C11	2.3	2.3	3.7	3.7	3.38	5.13	4.56	5.13

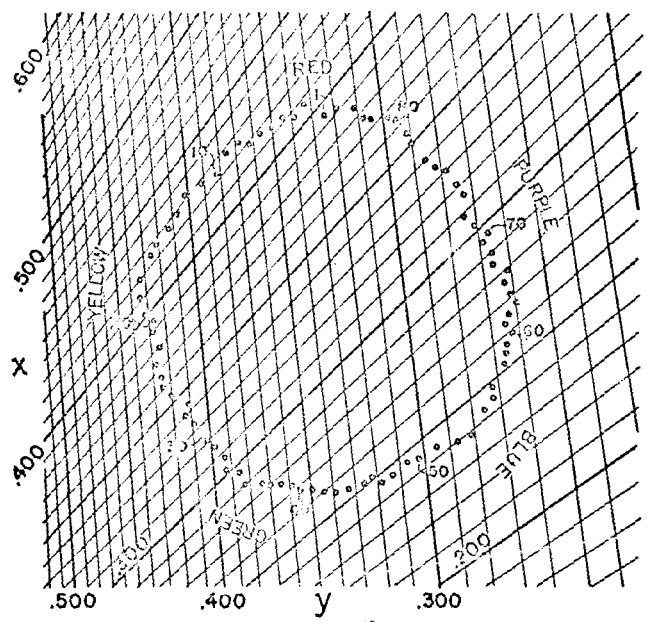
TABLE A4

PRE AND POST-TRAINING
UTILIZATION SCORES

Subject	Pre-Training Average (%)	Post-Training Average (%)	Pre-Training 'No-Error' Spaces	Post-Training 'No-Error' Spaces	Pre-Training Score	Post-Training Score
E1	82.5	78.5	21	23	3.93	3.41
E2	89.1	100.0	27	27	3.30	3.70
E3	83.8	88.8	18	25	4.65	3.55
E4	67.9	87.9	20	23	3.40	3.82
E5	43.8	46.0	15	17	2.92	2.70
E6	87.3	82.4	23	23	3.80	3.58
E7	14.6	25.7	11	14	1.33	1.84
E8	100.0	93.8	29	28	3.45	3.35
E9	81.3	91.7	25	25	3.25	3.67
E10	37.5	93.8	19	27	1.97	3.47
E11	27.6	35.1	11	11	2.51	3.19
E12	47.9	35.4	17	15	2.82	2.36
E13	46.7	54.2	8	15	5.83	3.61
E14	25.0	0.0	7	9	3.57	0.00
E15	66.3	80.4	23	21	2.88	3.83
C1	100.0	100.0	28	28	3.57	3.57
C2	100.0	100.0	29	27	3.45	3.70
C3	81.7	95.0	19	26	4.30	3.65
C4	93.8	56.7	25	16	3.75	3.54
C5	54.9	75.4	15	24	3.65	3.14
C6	91.7	100.00	22	28	4.17	3.57
C7	50.4	89.1	20	26	2.52	3.43
C8	62.2	77.4	23	25	2.71	3.10
C9	48.8	62.5	20	23	2.44	2.72
C10	96.4	100.0	25	24	3.86	4.35
C11	0.0	93.8	6	23	0.00	4.08

APPENDIX B

COLORIMETRIC DATA FOR FARNSWORTH-MUNSELL 100-HUE AND ICS TEST



Position of 85 100-Hue test colors on a perspective projection of the C.I.E. diagram.

[After Dean Farnsworth, The Farnsworth-Munsell 100-Hue Test, Baltimore, Munsell Color Company, Inc., 1957.]

TABLE B1

RANDOM ORDER USED IN
PRESENTATION OF
100-HUE TEST

Case 1																				
12	17	13	9	21	15	4	18	8	20	6	3	1	85	10	5	7	19	11	14	2	16
Case 2																				
33	41	36	32	34	40	27	24	28	38	25	22	39	23	35	31	26	29	37	42	30	
Case 3																				
62	48	54	56	61	46	59	55	49	47	50	63	58	52	44	53	57	45	60	51	43	
Case 4																				
80	66	72	84	77	81	65	69	64	71	67	73	83	74	68	75	70	82	79	76	78	

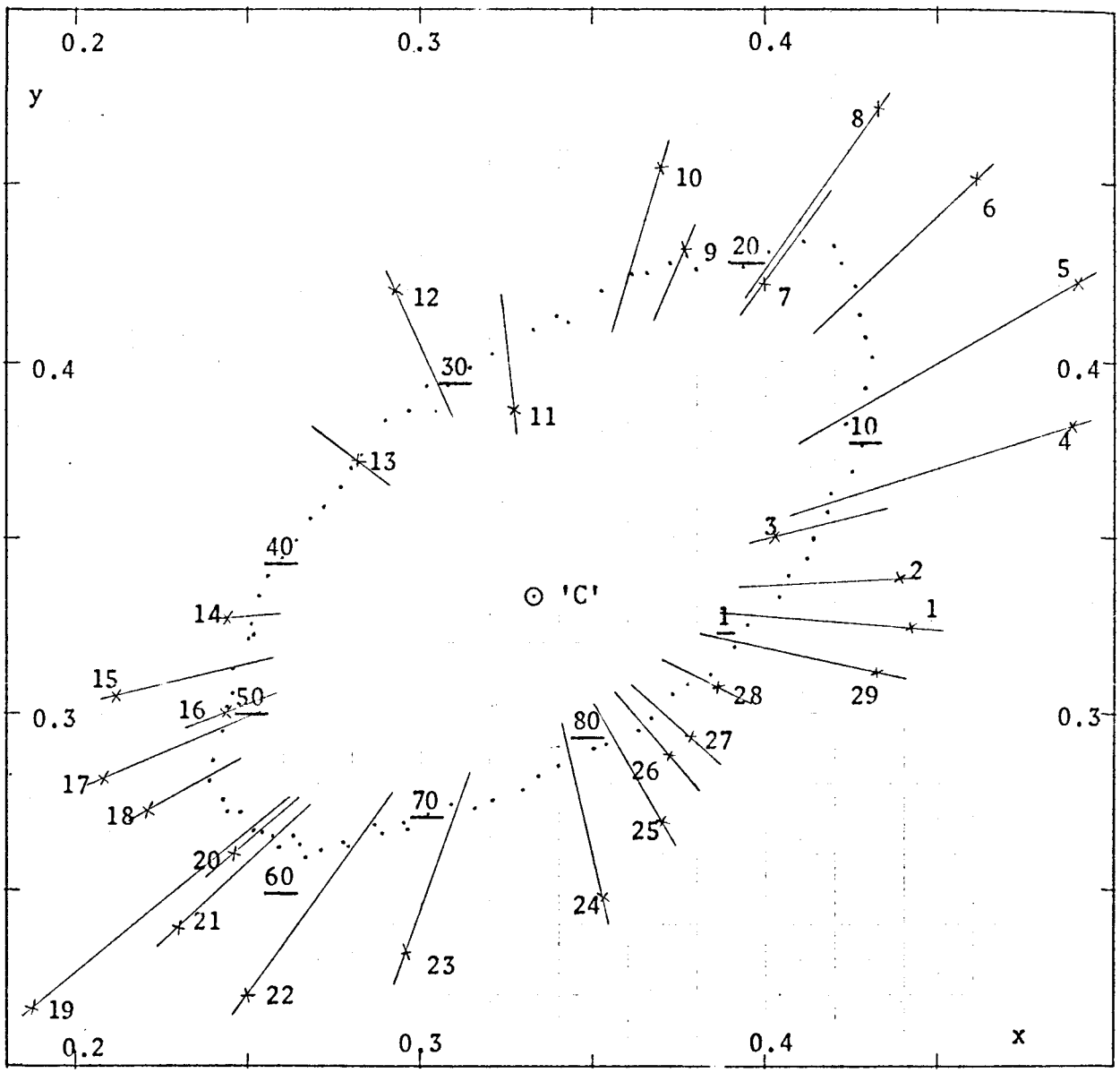
TABLE B2

COLORIMETRIC DATA FOR FELT MARKERS

Felt Marker No.	Corresp. 100-Hue Cap No.	Munsell Notation	x*	y*	Mfg. Marker No.**
1	1	5R 5/8	.442	.324	336-L1
2	3	7.5R 7/8	.439	.338	276-L9
3	5	10R 4/6	.403	.350	333-L
4	6	2.5YR 6/10	.489	.381	233-L
5	10	7.5YR 6/10	.490	.422	A-618
6	15	2.5Y 7/10	.461	.452	243-L
7	18	6Y 7/6	.398	.422	267-L
8	19	7.5Y 6/8	.433	.472	257-L9
9	23	2YG 7/6	.377	.432	A-606
10	25	5YG 8/8	.370	.455	208-L
11	30	7.5YG 7/4	.327	.386	A-608
12	32	2G 7/8	.293	.420	238-L1
13	37	5G 8/6	.282	.371	A-627
14	45	5BG 6/6	.244	.329	258-L1
15	48	7.5BG 4/6	.212	.305	258-L9
16	50	1B 7/6	.243	.300	205-L1
17	51	2B 6/8	.208	.282	A-486
18	53	5B 7/8	.221	.273	A-483
19	57	10B 5/10	.187	.216	A-480
20	58	2.5PB 6/6	.246	.260	A-489
21	59	3PB 6/8	.230	.239	A-427
22	66	8.5PB 5/8	.250	.220	A-405
23	72	6P 5/8	.296	.232	A-560
24	77	1RP 5/10	.392	.266	A-370
25	79	4RP 6/10	.370	.269	A-367
26	80	5RP 6/8	.364	.282	A-365
27	81	7.5RP 6/8	.378	.293	A-363
28	83	10RP 7/8	.386	.307	256-L1
29	85	2.5R 6/10	.432	.312	A-362

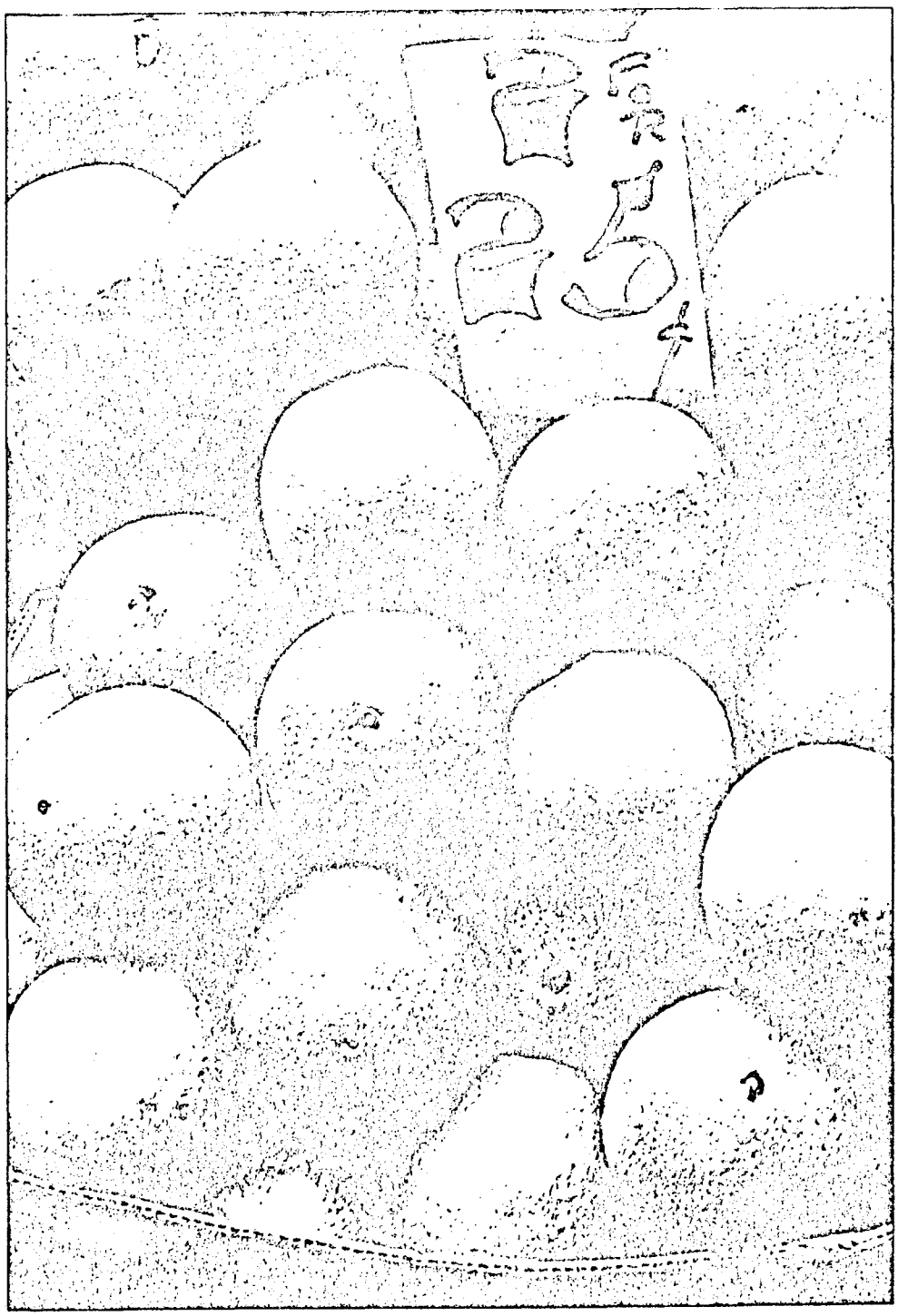
* From: Newhall, S.M. "Final Report of the O.S.A. Subcommittee on the Spacing of the Munsell Colors". J. opt. Soc. Amer., 33, 1943, p.385.

** Markers prefixed with 'A' are manufactured by Letraset Canada Ltd. The rest are made by Eberhard-Faber Canada Ltd.

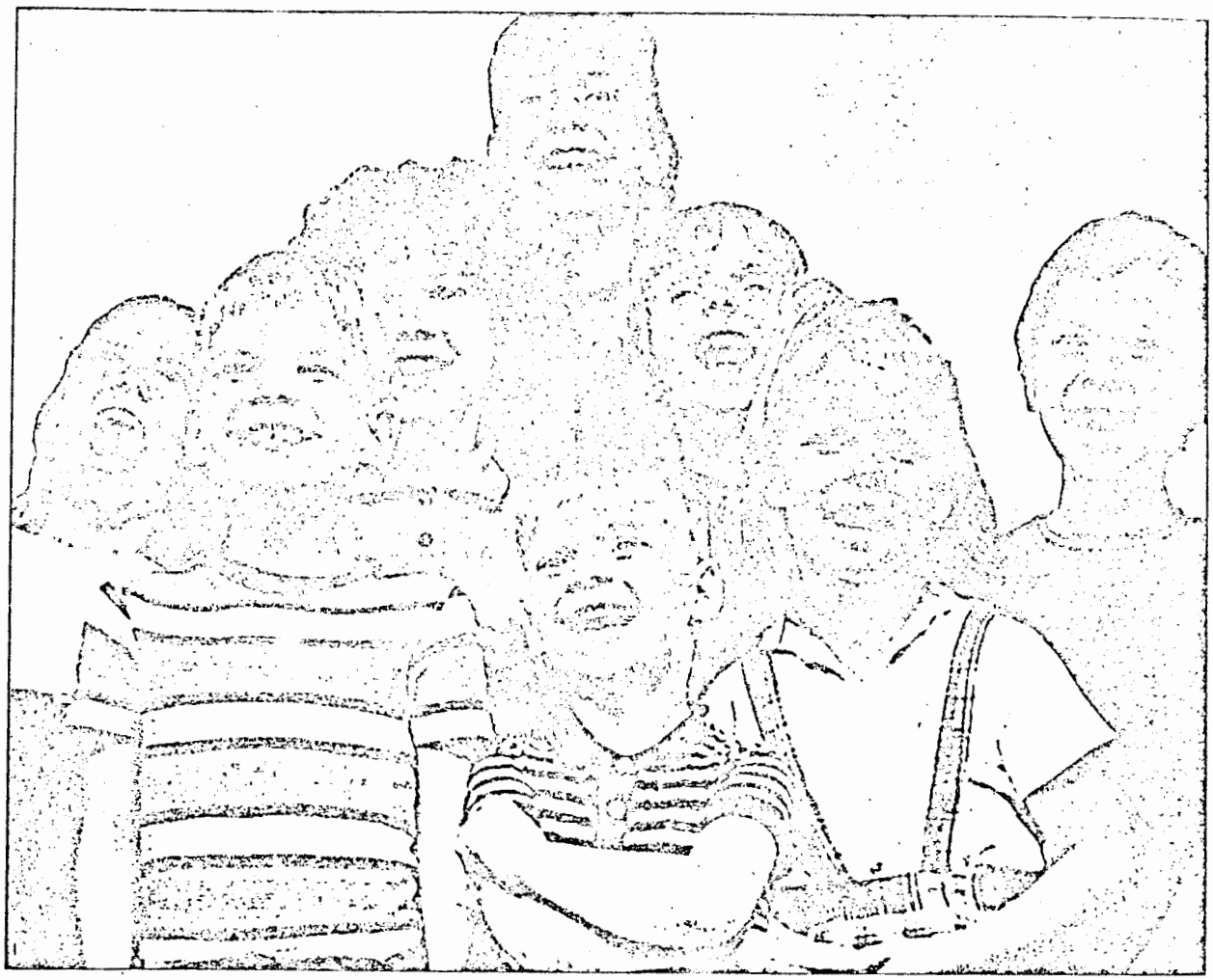


Distribution of 85 100-Hue test caps and 29 felt markers on the C.I.E. chromaticity diagram. Reference standard 'C' is indicated, and lines radiating from 'C' through markers show graphically the 100-Hue caps which most closely match individual markers on the hue dimension.

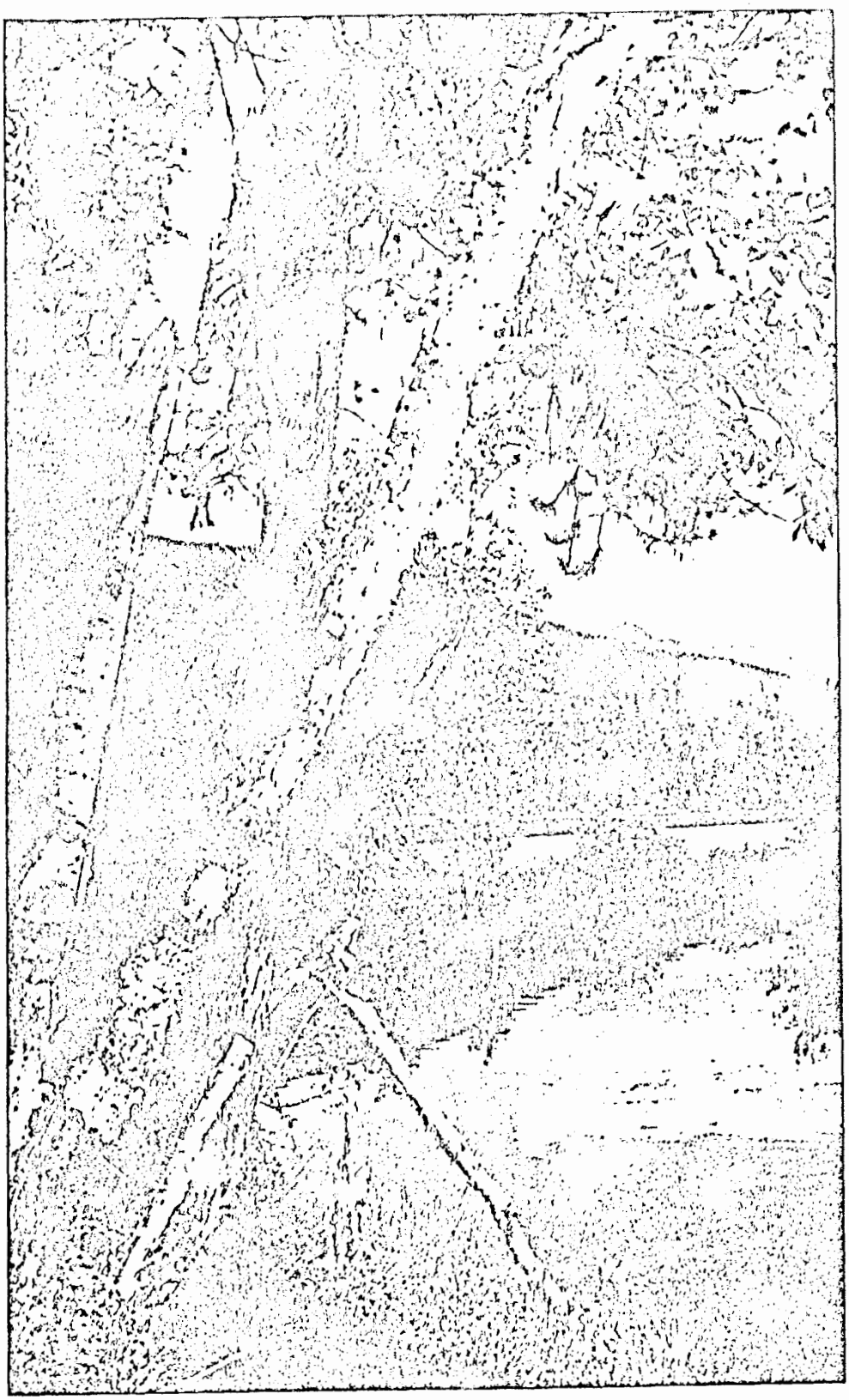
Regular numbers indicate felt markers.
Underlined numbers indicate 100-Hue test caps.



INDIVIDUATING THROUGH COLOR
Picture for 'Oranges' coloring task.



INDIVIDUATING THROUGH COLOR
Picture for 'Children' coloring task.



INDIVIDUATING THROUGH COLOR
Picture for 'Landscape' coloring task.

INDIVIDUATING THROUGH COLOR
Picture for 'Drama' coloring task.