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ABSTRACT

Aimed at advancement of the arts through improvement of education for both understanding and production, this long range basic research program dealt primarily with the study of the varieties and interaction of human abilities, the nature of the tasks involved in the several arts, and the available means for inculcating or fostering the abilities required to perform such tasks. Methods applied range from the initial clearing away of prevalent misconceptions and the clarification of concepts, through psychological experimentation and the study of clinical work on the brain, to actual field work in educational institutions and the arts. The underlying assumption was that work in the arts, like much human activity, involves the processing of symbols. First, a grounded organization of symbol systems and functions was developed. Then questions and hypotheses concerning the abilities required for the implications of this for the arts were framed and investigated. Throughout the study, however, any question or evidence that promised to further the objective was considered. Rather than offering art educators recommendations and conclusions, the report offers materials that may be of use in their thinking and practice. (Author)

Final Report

Project No. 9-0283
Grant No. OEG-0-9-310283-3721 (010)

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BASIC ABILITIES REQUIRED FOR UNDERSTANDING AND CREATION IN THE ARTS

September, 1972

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Office of Education

Bureau of Research

ABSTRACT

This long-range basic research program, aimed at the advancement of the arts through improvement of education for both understanding and production, was occupied primarily with the study of the varieties and interaction of human abilities, the nature of the tasks involved in the several arts, and the available means for inculcating or fostering the abilities required to perform such tasks. The methods applied range from the initial clearing away of prevalent misconceptions and the clarification of concepts, through psychological experimentation and the study of clinical work on the brain, to actual field work in educational institutions and the arts.

Starting from the observation that work in the arts, like much human activity, involves the processing of symbols, we first developed a grounded organization of symbol systems and functions. Questions and hypotheses concerning the abilities required for various kinds of symbol processing, and in particular concerning the implications of this for the arts, were then framed and investigated. But irrespective of our theory, we considered any question or evidence that promised to further our objective.

Our results are not recipes for immediate application by the arts educator, but material that may be of use in his thinking and practice.

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HEALTH, EDUCATION, AND WELFARE

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CHAPTER 1. A PROGRAM OF RESEARCH IN ARTS EDUCATION

1. Background and Beginnings

The ultimate purpose of Project Zero is advancement of the arts through improved education of artists, audiences, and management. As compared with education in other fields, education for the arts is sparse, sporadic, and chaotic. Programs and passionate convictions abound, but communicable general principles for planning sound programs and evaluating them are sadly wanting. We have been seeking such principles by examining the processes and human abilities peculiarly involved in the production or comprehension of one or more of the arts. Research so basic is inevitably long-range, with little probability of early applicable results. Yet in the course of our study to date some promising hypotheses have gained support.

To say even this much is to arouse antagonism. "If such research were carried out, the arts would be destroyed" is a characteristic comment. Many are convinced that everything related to the arts is by its very nature idiosyncratic; and that any analysis, any investigation of education -- even education itself -- is antithetical to the arts. Some of the opposition and obstacles to our effort will be discussed below (Section 1.3). But we must warn here against hasty conclusions as to our approach and its feasibility. We are not looking for mathematical formulas for nurturing abilities in the arts; rather we are studying the various possible ways that education may be made more helpful -- or at least less damaging -- to such abilities. We ask that our work be judged not by antecedent prejudices but its progress and results, tentative and partial as these may still be.

We began near zero (hence our name) with little more than a conviction of the importance of the task and some tentative notions as to where to direct our attention first. Bits of evidence, conjectures, apparently remote studies, perplexing questions, have come gradually to relate to and illuminate each other. These have suggested new hypotheses and lines of thought that have in turn brought to bear the results of other, often apparently remote, studies. If we have not done nearly what needs to be done, we at least know much better what we are doing. Progress has been made in draining the swamp, driving some pylons, starting foundations, erecting the scaffolding, and here and there putting in a door or a window.

A task as comprehensive and uncharted as ours required a theoretical framework that might later be elaborated, revised, or discarded. This need was filled by an approach to a theory of symbols detailed in Languages of Art (1968), a book completed by the director, Nelson Goodman, during the first year of the Project. Much of human knowing, acting, and understanding in the arts, the sciences, and life in general involves the use -- the interpretation, application, invention, revision -- of symbol systems. Such symbol systems may be classified into kinds according to certain significant characteristics. By identifying the kinds of symbol systems involved in a given phase of a particular artistic activity, we have gained some clues as to the skills required as well as to ways of

discerning and developing those skills. For example, the peculiar differences between linguistic and non-linguistic symbols -- once they are disentangled from the pseudo-difference between verbal and visual symbols -- may point to differences in the kind of training required to handle them.

This general approach has suggested many of our studies, and has led to the discovery of some intriguing relationships between our theoretical analysis and the work of psychologists and neurologists. These leads may well throw light on fundamental aspects of education for the arts. But our research has by no means been constrained by or confined to this way of thinking. Indeed, the Project has pursued several other lines of investigation that seemed essential for a comprehensive approach to education in the arts. For example, we have organized a taxonomy of educational methods. We have visited several institutions with active programs in the arts in order to observe their methods and examine their philosophies. We have given considerable attention to problem solving, which has impressed us as a process much more central to artistic endeavor than is generally thought. We have examined the perception of rhythm in music, and the role of rhythm as an organizing force in human development. The basic psychology of human vision and its implications for the visual arts have also been topics of analysis and experimentation.

Our inquiry has had to proceed, roughly, from our own experience and theoretical study to the formulation and clarification of relevant problems, then to the analysis of these into more manageable specific questions, and then to pertinent and directed observation and experimentation. In some aspects of our program we have already reached the experimental stage; in others, further work is still needed in crystallizing the conceptual apparatus in terms of which the crucial questions are to be framed.

2. Plans and Procedures

An early step in any investigation such as ours is to find out what has been done and what is being done: to read, consult, observe. But especially with a problem as broad and elusive as ours, determining what work is relevant and how, what questions to ask and what inferences to draw from the answers, requires prior and continued hard thinking. This accounts for the emphasis that we have from the beginning given to the analytic, theoretic, philosophical aspects of our study.

In our survey of printed matter dealing with educational and artistic questions, we have profited from such diverse works as Lowenfeld's Creative and Mental Growth (1947), Stanislavski's An Actor Prepares (1936), and Gombrich's Art and Illusion (1960). On the whole, though -- for reasons we suggest below (Section 1.3) -- the literature in the field is unrewarding, and often serves mainly to warn by example against pitfalls and blind alleys. The more illuminating work is frequently on topics less obviously related to our problem. For example, perception and

conception, organizing and reorganization, play such prominent parts in the artistic process that Piaget's studies of the child's organization of his experience are plainly pertinent (Piaget, 1954). So also, for equally clear reasons, are Burton White's studies of the effect of richness of environment upon the development of an infant's skills (1971), and studies by Bernstein (1967), Held (1965), and Bruner (1968) of the nature and role of motor activity and coordination. Other work such as Haber's (1964) and Strohmeyer's (1969) on eidetic imagery has challenged us to clarify the suspected relationship of such an ability to the problems we are investigating.

Our reading has been supplemented by consultations with educators, psychologists, and others; many experts have given valuable time to speak to us and discuss their work at full staff meetings. Some of our most promising ideas have come from such group conferences under the stimulus of visiting speakers.

Every effort has been made to augment reading and consultation with observation of operating programs in arts education in schools, universities, professional institutions and conservatories, and community arts centers. We have also sought opportunities to view lecture-demonstrations on the stage and in museums as well as dancers, musicians, and actors, in rehearsal and in performance. One of our early projects was a series of visits to colleges that emphasize the arts (e.g. Oberlin) and to high-grade professional schools (e.g. Rhode Island School of Design) to compare their aims and methods. Although this plan was curtailed by limitation of time and resources, and was initiated before our theoretical studies had gone beyond their earliest stage, the several visits that were made raised some important issues -- for example, the relative importance of a problem solving approach in arts education and the fundamental question of what a problem is in the arts (see 5.2.1 and 5.2.1.1). We have also upon request made practice evaluations of proposed or existing programs in arts education as a step toward developing some guide-lines for judgment (see 7.4). While we are in no position to make any pronouncements, we have profited by the contacts and our efforts to help.

Analysis, reading, consultation, and observation are preliminaries to experiment. Although our study has advanced only recently to the point where pertinent experiments could be designed and carried out, and although we have no laboratory facilities, considerable experimentation has taken place. Many of our staff members and consultants have engaged in experimental work in their primary academic capacities, work in part motivated by the Project's aims and directed toward resolving issues of special relevance to the Project. Contributions by as well as to the Project are evident in many reports of experimental work published by staff members (e.g. Kolers 1971); Kolers and Perkins (1969a,b); Gardner (1970a); Gardner and Gardner (1971). And recently, a few experiments have been conducted entirely in the context of Project Zero (e.g. see Sections 5.1.1.3 on music styles, 4.2.1 on picture perception, 4.2.2. on caricatures, 4.1.3.4 on rhythm perception).

Theoretical and long-range as our research is, it could not consist solely of work in the library, the conference room, and the laboratory,

even supplemented by observation in the field, in splendid isolation from the actual practice of the arts. Though none of us is an artist, we have immersed ourselves in the production of lecture-demonstration programs (separately supported), by professional artists in dance, music, poetry, photography, mime, and other arts (7.3.1). These programs have been at once studies in audience education, opportunities for close association with artists at work, and means of bringing us face-to-face with the complex problem and crises that arise daily in realizing a production. Another perspective has been gained by our participation in the new Institute of Arts Management of the Harvard Summer School. This program (separately financed) for present and prospective administrators of such arts organizations as orchestras, dance companies, art centers, and museums was founded at the suggestion and with the cooperation of the Project. The Project Director was a member of the planning committee, and of the faculty for the first year; and the Project planned some of the case work (see 7.3.2).

Finally, in the spring of this year Project members cooperated in a Project Zero course offered to undergraduate and graduate students of Harvard University. The aim was to present the Project's thinking on the arts, and to involve the students in designing and executing individual research projects under the supervision of various Project members. Fifteen students completed thirteen investigations (two were joint endeavors) on a wide variety of topics, and both instructors and students expressed general satisfaction with the seminar. Certainly this initial effort offered many lessons as to how the course might be organized in the future, and the Project plans to conduct the seminar again in the coming spring term and perhaps to expand it to a two term sequence in the future (see 7.3.3).

3. Opposition and Obstacles

Although we began by asking what had already been done, we soon found ourselves asking rather why so little had been accomplished or even attempted. What explains the dismal past record of failures, frustrations, and omissions?

Much of the trouble has lain in a motley collection of popular prejudices and philosophical fallacies concerning the arts, education, and even research methodology. Perhaps the most pervasive misconceptions construe art as a matter of immediate experience, emotions, and values in contrast with science as a matter of inference, cognition, and fact.
The conclusion is drawn either that the arts are unteachable or that methods for teaching immediate awareness, feeling, and appreciation must be sought. This line of thinking seems to us wrong in its conception of arts, in its tacit identification of education with teaching, and in each of its alternative conclusions. In part, it derives from venerable but untenable epistemological dichotomies: the 'given' or immediate versus the inferred or mediate, the emotive versus the cognitive. In part, it derives from isolating the functions of understanding and evaluation from one another, and absurdly assuming that while understanding is ultimate for science, 'appreciation' is ultimate for art. Without arguing the case here, we

invite consideration of consequences, for our present inquiry, of recognizing that the distinction between mediate and immediate experience may be illusory, that the emotions rather than being antithetical to cognition may be instruments of it, and that appreciation may be as subsidiary to understanding in the arts as in the sciences. Among other things, the problems of education for the arts may come to seem less idiosyncratic, or at least less hopeless; and agreement with the teacher's taste may be dropped as a test of the student's promise and as a measure of his progress.

Serious study of education for the arts has also been stunted and side-tracked by the prevalent notion that the arts are merely instruments of entertainment. Some newspapers list plays, concerts, and exhibitions under "amusements"; and among a week's amusements may be a Bach Mass, King Lear, and an exhibition of Goya's Disasters of War. No real progress in attitudes toward education can be hoped for when Cezanne's pictures are classed with cook-outs, and arts programs with playgrounds. On the other hand, we encounter almost as often the equally detrimental mistake of exalting the arts to a plane far above most human activities, accessible only to an elite.

Reaction against both these extremes has inspired elaborate arguments emphasizing extraneous psychological and practical virtues of training in the arts. It is held to soothe the spirit, sharpen the mind, increase effectiveness in daily pursuits, resolve social tensions, and so on. Whatever merit these arguments may have, they succeed mainly -- by their very existence -- in fostering the suspicion that the arts are worthless in themselves.

Further confusion results from the frequent mistaking of the problem of education in the arts for the problem of creativity. The study of creativity, whatever it may be, is part but not all or even the major part of our program. Ways of discovering and fostering originality, superior talent, genius, are surely wanted for the arts; but no more so than for the technologies and sciences. That we have no sure method of producing Edisons or Einsteins does not lessen the importance of providing training that they, and scientists and technicians in general, need: training in reading, calculating, solving problems, framing and testing hypotheses, proving theorems. The parallel problems for art still need urgently to be defined and investigated, whatever we are or are not able to do about creativity.

Overemphasis on creativity, emotion, immediacy has nourished the idea that art is a matter of pure inspiration, that a work blooms suddenly in the artist's consciousness and needs only to be embodied. (For some examples of this view, see Ghiselin [ed.], 1952). Rather, we maintain that inspiration -- welcome and exciting when it occurs -- is usually sporadic and partial; and realization, whether in physics or painting, in medicine or music, is normally an ardous process, straining skill and pertinacity. The romantic identification of art with inspiration discourages serious examination of what is involved in production or understanding of the arts.

Damaging in a different way is the delusion that we have clear and reliable standards for judging the merit of works of art. A sensible measure of success in education for the arts might seem to be the excellence of works subsequently produced or preferred by the students. The trouble is that the criteria of excellence are highly provincial and transient. One cannot confidently endorse a school that produces a generation of Rosa Bonheurs, no matter how evident testimony to success this may seem at a given time and place. Nor is departure from current standards any better measure than conformity; production of work in accordance with or in defiance of whatever canons happen to be locally and temporarily in effect is a dangerous test.

We are not suggesting that there are no standards of artistic merit or that one can forego all judgment of quality of works produced in appraising an educational program. But the standards are too elusive and the judgments too personal to provide the basis for any dependable method of validation. This proves a major problem at the very beginning of our study. In most fields there are reasonably accessible measures of success; winning races or tournaments, making profits, raising standards of living, reducing crime and poverty, reaching the moon. If there is no ready criterion for the goodness of a work of art, how are methods of art education to be evaluated? Part of the answer is that we must depend rather heavily upon antecedent analytical study of how human beings function in performing tasks involved in comprehending and producing works of art. But whatever care we exercise in formulating credible hypotheses, they must be subjected to some experimental control; and finding how to do that will give us some trouble. One reason the urgent and exasperating problem of evaluation has been neglected is that as matters stand almost any effort at education in the arts can plausibly claim success. For, by the well-known Hawthorne effect (Mayo, 1933), even pointless or ill-conceived attention may prove an effective placebo in improving performance. Nonetheless, we have reached certain tentative conclusions about evaluation which are detailed below (Section 7.4).

A hampering misconception about education rather than, or in addition to, a misconception about art is disclosed in arguments to the effect that because art (for one reason or another) is unteachable, education for the arts is useless or even detrimental. Whatever the truth of the premise, the conclusion does not follow. Education must not be equated with teaching, or even with schools. Coaching, apprenticeship, demonstration, cooperative assistance, etc. are effective means for the improvement of some abilities. What is unteachable may well be trainable, or amenable to other educational methods. The distinctions and interrelations between the several aspects or modes of education -- that is, of inculcating and developing abilities of various kinds -- need careful examination. This painstaking analysis and clarification of educational procedure in general is particularly important for progress in our special study (see 7.2).

Some more specialized miscues have resulted from serious but misdirected efforts to deal with particular problems. One example is the current insistence by many arts educators upon contrasting the verbal and the visual. The difference between poems and paintings -- between

the verbal and the non-verbal -- is highly significant. But to characterize this difference by the terms "verbal" and "visual" is to overlook the fact that the verbal is as often visual (e.g., in reading) as not, and that the non-visual (e.g., auditory) is often non-verbal. An unhappy synecdoche has made for a mix-up.

4. Convictions and Conjectures

Pointing to all these misconceptions implies some underlying positive principles. Some attitudes, hunches, and hypotheses pervading our study have operated from the beginning; others have emerged in the course of our work. Some were convictions; some conjectures; but all were subject to revision as the study proceeded.

Underlying our approach are two acknowledged prejudices: that art needs no justification in terms of anything else, and that what counts is quality rather than quantity -- better pictures rather than more, better insight than bigger audiences.

Like understanding and discovery of all sorts -- from the simplest perception to the most subtle pattern detection and the most complex conceptual clarification -- comprehension and creation in the arts are not matters of passive contemplation or pure inspiration but involve active, constructive processes of discrimination, interrelation, and organization (Neisser, 1967). Accordingly, sensation is no longer isolated from thought, the several senses from one another, or the arts from the sciences. Perception and problem-solving and painting have much in common. Bernstein's work (1967) suggests that even the performance of seemingly simple physical tasks may involve mastering complex problems of coordination. We are thus encouraged to examine the skills or abilities involved in all these active processes, look for those most central in the several arts, and ask what educational means are appropriate to develop these abilities; we hope to measure improvement in these abilities in terms of increased success in performing certain specifiable types of tasks.

Education is preparation for the performance of subsequent tasks. It depends essentially upon transfer of learning; what is learned must be applied to further tasks of the same kinds or to tasks of other kinds. This is not to accede to a discredited 'faculty psychology' -- to suppose that there is a fixed and fundamental set of atomic skills. Rather, our effort has been to devise a taxonomy of tasks and of abilities to perform them that is serviceable for our particular purposes, and then investigate how development of some of these abilities may enhance or inhibit the development of others. As already suggested above, one clue to such a taxonomy is the recognition that almost all the processes under consideration involve extensive operation with and upon symbols of various kinds. Sentences, gestures, diagrams, maps are incessantly devised or discovered, applied, interpreted, revised, rejected, supplemented, translated. We have sought to apply the systematization of symbol theory begun in Languages of Art to the study of the differences and interrelationships among the abilities involved in the arts.

Our guessing is by no means confined to such theoretical matters. As we have worked, more particular opinions on methods of education in the arts have inevitably emerged. Some of these will appear in the course of this report; but all are set forth cautiously with implicit disclaimers of responsibility for the consequences of adopting them. We are in no sense offering a handbook of art education.

5. Staff and Support

Funds for these investigations have been provided during the past two years by the U.S. Office of Education (Grant No. OEG-0-9-310283-3721 (010)), and in earlier years by the National Science Foundation (Grant No. GS-2196), and the Old Dominion Foundation. This support has been enormously augmented through generous contributions of time and effort by members of the staff. Only a small part of the time devoted to the Project by the staff has been paid for. Some members have worked entirely without pay; no one has been paid for nearly all the work he has done.

The staff consists of faculty and graduate students trained variously in analytic philosophy, mathematics, education, or psychology -- all of them with some special interest or competence or experience in at least one of the arts. In addition, we have had the services, as staff consultants, over an extended period, of a psychologist, Dr. Paul Kolers, and a philosopher of education, Dr. Vernon Howard.

We have, furthermore, had the cooperation of many members of the Harvard Faculty -- e.g. Roger Brown, Jerome Bruner, William Warntz, Burton White, Peter Wolff, Norman Geschwind -- and of other visiting speakers on various subjects such as Ralph Haber on eidetic imagery, David Premack on language in chimpanzees, and Frank Jones on stereotyped response patterns and postural sets.

The core members of the staff, and the two consultants, have worked together on the Project for from two to four years, with frequent full staff meetings, group conferences, and individual discussions with the director and with each other. Our different training and points of view have both modified and supplemented each other, and we have developed a working mutual understanding on basic matters and a way of cooperating in our joint enquiry.

6. Plan of this Report

In this first chapter, we have been trying to give some idea of our problem and our program, our procedures and our prejudices. In the following chapters we want to outline the work we have done; to indicate something of the course of our thinking and study along the way; to show how some problems have been sharpened, transformed, or dissolved while others have become more stubborn; and finally to summarize conclusions reached, dead ends, live leads, and what now impress us as the most urgent, the most difficult, and the most promising remaining problems.

How much space we give to each topic below depends not only upon how much work we have done on it and how interesting the results seem, but also to some extent inversely upon how much has already been said upon the topic in one of our Technical Reports or in books or articles by members of our staff. The appendix lists these materials and describes where they may be found. In no case, however, do we attempt more than a summary here, accompanied by references to other available literature.

We hope to share with the reader the course of our own thinking by beginning in Chapter 2 where we began -- with the basic distinctions introduced in Goodman's Theory of Symbols. In no sense has this theoretical work dictated or circumscribed future research: indeed much of our research was begun independently and some of it has modified points first raised there. Nonetheless the range of questions that have occupied Project members, and our sense of which questions were promising, which not, have been influenced significantly by the argument presented in Languages of Art. Any account of the Project should begin with a description of this work.

Though the Project began with a philosophical work, the major part of our research has been directed toward psychological and educational issues. This emphasis is reflected in the amount of space devoted to accounts of experiments and educational programs. Nonetheless the philosophical origins of the Project have been reflected in at least three ways. First, there have been continuing studies on a number of technical questions about symbol systems. These are reported in Chapter 6. Second, several aspects of our work in psychology arise from or are closely connected with the theory of symbols (Chapters 3, 4, and 5). Third, we have sought to apply standards of clear and systematic thinking to areas where careful definition and utilization of concepts is often wanting -- in particular to the areas of education and the arts. We hope that our efforts toward philosophical rigor are reflected in the educational and psychological studies, as well as in the more technical philosophical analyses.

The theory of symbols is particularly consonant with a certain view of the human organism and raises pivotal questions about how humans deal with complex stimuli, such as those involved in the arts. In Chapter 3, as a prelude to an account of our psychological research, we detail our view of the human perceiver and creator as an active, constructive organism; we then illustrate how a particular tenet of the theory of symbols -- the difference between linguistic and non-linguistic systems -- intersects fruitfully with recent findings about human psychological functioning and neurological organization.

The next two chapters are concerned with a score of specific studies concerning skills involved in artistic production and perception. Summarized first are some investigations of the perception of music; we then move on to the perception of different kinds of pictures, ranging from simple line drawings, to caricatures, to pictures which are felt rather than seen. The review of our psychological studies concludes with a wide-ranging discussion of various general approaches we have adopted in an effort to elucidate artistic perception and production; included are analyses

of how children become able to focus on subtle aspects of artistic stimuli, how individuals work with various arts media, the nature of problem solving in the arts, an introduction to "pathologies" of problem solving, and a discussion of the relation between automized routines and creative production in the behavioral organization of the individual.

In the research reported we have emphasized the arts of painting and music. This emphasis results in part because of the special interests and training of individual Project members, in part because these art forms utilize symbol systems which have been less frequently (and perhaps less authoritatively) studied than ordinary language has been. We regret that we have not had the opportunity to study the arts of dance, drama, playwriting, poetry and would hope that future studies will include the entire spectrum of art forms.

Following the description of four inquiries into specific aspects of the theory of symbols in Chapter 6, we give an account of that portion of our work most explicitly concerned with education. We describe our site-visits to various institutions of art education, introduce a taxonomy of methods of education, and evaluate our own efforts in art education: the sponsoring of lecture-performances, the initiation of and participation in a training program in arts management, and the launching of a course based on the Project's own work. Chapter 7 closes with our preliminary conclusions about one of the most difficult problems in education: that of evaluating an instructional program.

CHAPTER 2. THE THEORY OF SYMBOLS

The general theory of symbols outlined in Nelson Goodman's Languages of Art has provided an impetus and theoretical framework for much of the work of the Project. Of special importance is the analysis and comparison of symbol systems in terms of characteristics required for a strictly notational system. Exposition of some details of the theory of symbols is indispensable to a thorough grasp of the work of the Project; but some readers may prefer to skip these technicalities until they have gained a more general view of the work from the rest of this report.

The present chapter, in addition to outlining the general theory will touch upon four other features which are particularly relevant for artistic studies and which have been central in Project work: the issue of "authentic" vs. "fake" works of art, the nature of expression, the nature of representation, and characteristics differentiating symbol systems in the arts and sciences.

While the nature of symbol use has interested philosophers for decades (e.g., Cassirer, 1953; Langer, 1942) "symbolic behavior" is often treated as if it were somehow all of a kind or confined only to linguistic systems. A theory of symbols adequate for an aesthetic psychology must encompass not only language but non-linguistic symbol systems including, for instance, those which are gestural, pictorial, musical, mathematical, or diagrammatic. Most discussions of "media" (cf. McLuhan, 1964) treat a medium as something peculiar to a single sense - a church bell announcing that services will soon begin or traffic lights signifying "stop" or "go". Symbol systems and media are different and complementary concepts. The same medium (e.g., sound) may be a vehicle for different symbol systems (language, music), or the same symbol system (natural language) may occur in different media (sound, print). This suggests that important differences between language and other sorts of symbol systems are blurred in a classification by medium which stresses differences in sense appeal over more fundamental syntactic and semantic features; and also, that an analysis in terms of symbol systems is required for an understanding of media.

1. Notationality: A Measure of Symbol Systems

How then may we describe, perhaps even measure, the differences in symbol systems? What, for instance, distinguishes pictures from paragraphs, graphic representation from linguistic description? It cannot be anything intrinsic to the symbols themselves if only because "OO" may function as letters in the alphabet in one system and as Little Orphan Annie's eyes in another. One means of analysis is the concept of notationality, in particular the various independent conditions of notational as opposed to non-notational symbol systems. Briefly put, a notational system consists of a set of separate, discontinuous characters (e.g., a musical score) correlated with a field of reference which is similarly segrated, (e.g., sounded pitches) so that any character in the system, isolates what object or objects it stands for, or, conversely, an object, isolates what character is correlated with it. Notationality contrasts with a continuous, unsegrated (e.g., pictorial)

system for which no alphabet or set of disjoint characters exists. A more formal account of this intuitive distinction between symbol systems runs as follows.

A symbol scheme consists of the characters of a symbol system irrespective of their reference or what they stand for. Thus, the characters "a", "b", "c" . . ., and combinations of them (also called characters) constitute the symbol scheme of English, the staff and various note and clef signs that for music, and so on. A character may be formally defined as the class of all inscriptions or utterances of it, so that each of "a", "A", and "ɑ" are said to be a-inscriptions or to "belong to" the character "A": (Goodman, 1968, pp. 131, 143-succeeding references are to this work). To be notational, a symbol scheme must satisfy two syntactic conditions. First, it must be syntactically disjoint; that is, no inscription can belong to more than one character (pp. 132-133). This condition eliminates confusion about the character to which a particular inscription belongs, assuring textual identity--sameness of spelling, as it were--across the variety of shapes exhibited by different handwriting and type faces.

Although an a-inscription by any other shape is still a 'true copy' or 'replica' of an 'A', we must nevertheless be able to distinguish it from other marks which are not a-inscriptions. This second condition is called syntactic finite differentiation (or "articulateness") which stipulates that for any two characters of the scheme (say, 'A' and 'B'), a given utterance or written inscription which does not belong to both can be determined to belong to neither or at most one of them (pp. 135-136). As Goodman observes, "The syntactic requirements of disjointness and finite differentiation are met by our familiar alphabetical, numerical, binary, telegraphic, and basic musical notations; and by a variety of other describable notations, some of them having purely academic interest" (p. 140).

Pictorial systems, on the other hand, typically violate both syntactic requirements of notationality inasmuch as their visual surfaces are not composed of inscriptions definitely assignable to characters in a notational scheme. On the model of a notational scheme, a system of picturing is syntactically dense, because it "provides for infinitely many characters so ordered that between each two there is a third", such that "no mark can be determined to belong to one rather than to many other characters" (p. 136). The same is true of analog computers or undifferentiated pressure gauges and temperature scales (pp. 159-160).

A symbol system is a symbol scheme with a correlated field of reference (p. 143). Such a system is notational if and only if it meets three additional semantic requirements. First, the characters of the system must be unambiguous (pp. 147-151). A character is ambiguous if different inscriptions of the character have different referents--as some inscriptions of the word "cape" apply to cloaks, some to headlands.

Second, like the characters of a notational scheme, the referents of a notational system are entirely segregated or semantically disjoint. No two characters in the system have any referents in common (pp.151-152). This amounts to the prescriptions of class inclusion (e.g., "All cats are mammals") and class intersection ("Some cats are white") - conspicuous and economical features of most natural languages. Natural language thus has a notational scheme but is not a notational system. Among other things, this means that "While a good definition always unequivocally determines what objects conform to it, a definition is seldom in turn uniquely determined by each of its instances" (p. 129). A given man may conform simultaneously to "featherless biped" and "English gentleman" and numerous other descriptions none of which is uniquely the description which denotes him. A standard musical score, on the other hand, is recoverable from the sounded pitches and durations it uniquely determines.[1] This mutual recoverability of score and performance, possible only in unambiguous and disjoint systems, serves the double purpose (as do most art notations) of guiding performance as well as identifying a work through good and bad performances by many performers (pp. 127-130).

Third, semantic finite differentiation parallels but does not follow from syntactic articulateness and stipulates that for any two characters of the system, and any object m which does not belong to both, it must be possible to determine that m complies with at most one of those characters (pp. 152-153). For example, if musical tradition did not limit minimum durational difference at the 1/128 note, a sounded pitch could then belong to an infinite number of note-inscriptions for all that we could determine; and a system of this sort is said to be semantically dense (p. 153). In fact, many modern methods of scoring music, devised in quest of maximum or minimum control over performance, are neither syntactically nor semantically differentiated, and are therefore, strictly speaking, non-notational (pp. 187-191).

Given the bewildering array of symbols and kinds of reference, the extreme syntactic and semantic requirements of strict notationality provide a convenient way of classifying other important types of symbol system which may be distinguished by violations of certain combinations of the notationality conditions. This permits comparison and classification of the varied symbol systems of art, science, and everyday life in ways illustrated above. There may also be significant differences in the psychological mechanisms involved in the manipulation of notational and non-notational systems which experimental study combined with a precise taxonomy of symbol systems can clarify (section 3.2).

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1. Barring some redundancy in the scheme (e.g. C , D) and non-notational instructions (e.g., dynamics marks, figured bass, linguistic instructions). See p. 151 and pp. 181-185.

2. Some Issues in Aesthetics

While the analysis of notational systems is a central theme of Languages of Art, a number of perrennial issues in aesthetics are directly or indirectly illuminated, for example, the controversial question of the difference between a forgery and a "real work" or original.

2,1 Authenticity and Notationality

Why is it that a copy of Rembrandt's Head of Christ, however, exact, is not considered a genuine instance of the work, while there are many (good and bad) performances of Beethoven's Pastoral Symphony, each no less genuine or authentic than another? The answer seems to lie in the amenability of an art to a notation which determines the "constituent" (identifying) properties of a work while leaving others contingent and variable (Goodman, 1968, pp. 115-116, 120-121). In those arts for which notations have been devised (e.g., music, dance) authenticity or work-identity consists in performances complying with a score rather than "identification of the actual object produced by the artist" (p. 118). The latter can be forged, whereas the former cannot. Those works and arts which admit the possibility of forgery are said to be "autographic", while those which do not are called "allographic" (p. 113).

2.2 Expression and Representation: A Difference in Direction

Two distinctions raised in Languages of Art have helped to clarify the nature of artistic works and discussion of them.

Not only do works of art sometimes describe and represent things, they also exemplify structural properties and express metaphorical ones. One difference between description and representation on the one hand and exemplification and expression on the other is in direction of reference. Any label (predicate, picture, gesture) which correctly applies to an object is said to denote that object. In exemplification, reference is made from an object to a label which properly denotes that object (Goodman, 1968 p. 59). For instance, a red paint sample is both denoted by and exemplifies the label 'red'. Exemplification may be of literal or metaphorical labels. Expressed properties of works are analyzed as cases of metaphorical exemplification. Thus a musical passage expressing melancholy is interpreted as referring to melancholy, where 'melancholy' is a label that applies metaphorically (but not literally, since only persons can be literally melancholy) to the music. Note that an expressed property is not necessarily the same as what one feels in reaction or response to a work. A sad song may evoke happiness and a scene of despair inspire pity. This suggests a way of accounting for the "emotive" content of art in terms of actual properties possessed by works as opposed to the rather arbitrary and variable manner in which works may move audiences.

Whereas expression is metaphorical exemplification in a semantically dense system, representation is denotation in a system that is syntactically dense (See pp. 52-53, 252). This allows for expression of

properties that do not belong literally to a symbol (e.g., colors by music, sounds by painting) and representation by systems other than pictorial ones (e.g., musical or gestural representation). By linking expression and representation to exemplification and denotation respectively, we are in a better position to appreciate the variety of expressed properties and representational systems in art. We also avoid the shortcomings of attempts to explain expression and representation by an amorphous relation of "imitation" or "similarity" either to the properties expressed or to the things represented (pp. 230-231, and Goodman, 1970).

2.3. Art and Science: A Difference in Dominance

The dichotomy between art and science is a traditional one much in need of clarification. Though no hard and fast line can be drawn between the symbol systems of art and of science, there are significant differences in the predominance of certain characteristics. Rather than a fixed set of criteria, Goodman suggests four "symptoms" of the aesthetic: syntactic and semantic density discussed previously, as well as syntactic repleteness and exemplificationality (1968, pp. 252-253). Syntactic repleteness is what distinguishes a sketch from a diagram or the "more representational among semantically dense systems from the more diagrammatic" (p. 252) by the number and variety of constituent features. In a line drawing, for example, all surface features are relevant -- colour, varying widths of line, texture, and contrasts of line and background, whereas in a graph or cross-sectional diagram, the only relevant feature is the exact location of points along a line (pp. 229-230). Exemplificationality refers to the properties which are literally exhibited (e.g., trochaic footing, sonata-allegro form) or expressed (e.g., melancholy) by a work as contrasted with those a symbol may describe, name, or represent (pp. 52-57, 253). Together the four symptoms may be conjunctively sufficient or disjunctively necessary for the aesthetic, though taken separately, they are neither necessary nor sufficient (p. 254).

All this is quite distinct from the question of aesthetic merit. Whether an experience or symbol is aesthetic depends less upon what we feel or the quality of the work or performance than on the presence or absence, dominance or subordinance, of certain sorts of symbol relations.

CHAPTER 3. PSYCHOLOGICAL APPROACHES

Some comprehension of the artist's and critic's special abilities is needed in the search for means of enhancing production of and insight into art. But both the beholder and producer of art call on the same fundamental capacities for language, problem solving, learning, manual skills, and the like that mediate all human activity: no single special skill distinguishes artist or understanding audience. Rather, we propose, a constellation of skills appropriate to a particular medium or symbol system underlies effectiveness in that medium or system. Thus, to assess the range of human abilities relevant to aesthetic endeavor, the Project has examined a broad spectrum of materials from psychological literature before proceeding to more specific investigations of perception and production in specific art forms. In this chapter we will describe a general approach to human psychology consonant with the theory of symbols, and illustrate it through a discussion of the scanning of pictures and of the phenomenon of apparent motion. As a further example of the interplay between philosophical and psychological thinking in the work of the Project we will show how recent evidence from neuropsychology helps to test the adequacy of a fundamental distinction in the theory of symbols - the difference between linguistic and non-linguistic systems. Descriptions of the more specific research projects on artistic perception and production will be given in the following chapters.

1. The Role of Cognition and Construction

Though psychology of art is a traditional area of study, this phrase has quite different meanings for different individuals. For those trained in the psychoanalytic tradition, the study of the arts centers about the motivation of the artist and the audience (Rank, 1932). The artist is seen as working over his personal problems in his artistic productions; the underlying content of works (usually sexual) is viewed as a common bond between producer and consumer. In contrast, those with academic training in psychology often adopt the approach of the Gestalt school to the arts (Arnheim, 1954). Here the focus is on certain laws of perception, which are presumed to govern and organize all perceptual experience from birth, and on certain qualities, such as balance, expressiveness, and harmony, which are considered basic to and desirable for all artistic works.

Nor do these two schools exhaust the field. Psychophysicists have examined the pleasingness of various sounds and shapes (Birkhoff, 1933): behaviorists have linked artistic pleasure to schedules of reinforcement (Skinner, 1953); educational psychologists have investigated the processes underlying creative (divergent) thought (Taylor and Barron, 1963). The Project does not embrace one of these schools to the exclusion of others; nor does it reject the findings of any school, merely because the underlying philosophy may be less than fully coherent. Indeed we have found refreshing insights from a range of psychological perspectives. Nonetheless an approach to psychology which has recently been termed "cognitive" or "constructive" psychology does appear to capture more of the aims and tenets of the Project's research than do the more traditional schools. For this reason it merits closer examination.

The classical approach to the study of perception concentrated upon biophysical and psychophysical parameters, and the work was aimed at elucidating the operation of the sensory "transducer". But - to mention just one limitation - the stimuli used necessarily constrain the results that are obtained, and detecting single or even multiple flashes of light when they are presented to various parts of the eye taxes more the subject's patience than his cognitive skills. Of course we do not deprecate these psychophysical studies, for they have generated important data regarding the capabilities of detection inherent to the sense organs. Respecting these data, we have nevertheless sought to study perceptual processes that involve more complex skills of identifying, imagining, ordering, and creating; we have used more complicated stimuli, that is, but often have studied them by traditional procedures. Hence we have concentrated more upon what the perceiver can make of or do with the stimulus, than upon the more simple responsive characteristics of the sense organs.

In speaking of "cognitive" or "constructivist" psychology, we define our interest as going beyond that of the psychophysicist's concern with the sensory "transducer" to the level at which the person, in ordinary commerce with his environment, samples its informational riches and on the basis of these samples "constructs" for himself their representation. These constructive activities reveal an interaction between the information the environment provides, and information the observer supplies. The latter is sometimes described as the role of memory or perceptual skills on perceiving, and can be illustrated with studies of how people look at pictures.

Evidence for the constructivist view and evidence particularly relevant to the pictorial arts, comes from studies of the way people look at pictures that are too big to be wholly contained within the small central region of maximum visual acuity. These studies, based largely on the data collected some years ago by G. T. Buswell (1935) and long neglected by psychologists, reveal several facts of interest. One is that a number of remarkable similarities can be found between the way people look at pictures and the way they look at text; while not overlooking differences between text and pictures described in chapter 2, one can usefully talk about the "reading" of pictures in that people look at parts of pictures over time, and on the basis of these looks create for themselves a representation of what they are looking at. Studies of eye movements reveal a significant disparity between the physical facts - the sequential sampling movements of the eye and the perceptual experience - a whole picture. The sense of the perceptual whole is clearly something constructed by the perceiver.

A second fact of interest is that different people tend to show very little agreement in the particular sequence of movements of the eyes; moreover, the same person does not examine different pictures in the same way. Yet in some sense they come away with perceptions of the "same" picture. The means by which these disparate sequences are transformed into common perceptions is not known in detail, but the occurrence of the phenomenon again implicates a sampling and filling-in strategy.

A third point is that despite these great differences in sequence, people "agree" markedly on the area of pictures that require the greatest number of looks. Hence, they seek information from common areas, but do so by idiosyncratic means.

As another example of this constructivist approach, we have considered with special interest Project member Paul Kolers' work on apparent motion (Kolers, 1970, 1971). The most familiar example of the phenomenon is the moving picture. Frame follows frame, each slightly different from the preceding, yet the observer perceives only smooth and continuous motion of objects. In the simplest laboratory demonstration of this phenomenon two similar objects are presented to different regions of the retina. When the tuning is adjusted properly, one sees a single object move smoothly and continuously from its onset at one location to its offset at another. Even this simple case illustrates dramatically the power of the visual system to supplement the information presented to it, for, of course, the object is not physically present between the two locations, yet an object is seen to be there.

What limits characterize these constructional activities of "dynamic supplementation" or "impletion", as they have been called? Will any two objects give rise to a perception of motion? Is simple spatial translation the only operation the visual apparatus can perform on sequenced presentations? Recent research by Kolers has at least partially answered some of these questions.

A great variety of motions can in fact be achieved. Most of his experiments have been done, not with simple bars or points of light, but with more complex plane figures, such as triangles, rectangles, trapezoids, and also figures with internal detail. Figures which are geometrically similar and have the same orientation readily appear to translate into one another. Similar figures at different orientations will translate and rotate. Various other sorts of motion can be produced with appropriate stimulus pairs, including not only motions in the plane, but motions through space, such as characterizes a door swinging back and forth.

All motions discussed so far, however complicated, are motions of rigid geometric objects. But appropriate stimulus conditions can elicit quite another sort of phenomenon: "plastic deformation". If, for instance, a circle and a square are presented in proper sequence, the circle will appear to deform smoothly into the square and vice-versa. It is not true, however, that any stimulus pair will yield motion or plastic deformation. For pairs especially "dissimilar" there will sometimes be no sense of motion, or only the sense that something has moved, without any clear perception of what the thing was that traveled between the two target placements. Here, of course, the word "dissimilar" must be taken with caution. Rather than describing the effect by saying that good motion occurs between targets that are sufficiently similar, one might better say that occurrence of good motion is a criterion of a certain sort of similarity. The phenomenon is not to be explained by, but might be used to define, similarity of figure.

This entire range of phenomena dramatically demonstrates the constructive powers of the visual system. An object is seen in motion and deformation where no object exists in the stimulus. The motion seen represents a remarkable effort of the visual system to interpret the two given stimuli as the initiation and terminus of a single integrated action in space.

Such considerations of 'basic psychology' have by no means dominated our attention; rather we have supplemented them with studies of even more

complex kinds of pattern recognition: students' ability to perceive "style" in stories and paintings, (5.1.1.1; 5.1.1.2), and rhythm and pattern in music (4.1.3.1, 4.1.3.2, 4.1.3.3). Surely ten years ago, and perhaps to some extent even today, the study of such "subjective" variables would have been relegated to the nether regions of psychology and education. Restricted to studies of what people prefer or like, the older approach to aesthetics and art was necessarily limited in its breadth and implications. But by attempting to dissect out some of the skills and some of the procedures that go into perceiving and judging, rather than only quantifying the perceptions and judgments themselves, we have striven to give these "soft" topics a hard footing, to treat with the rigor of scientific method the phenomena of aesthetic perception.

2. Brain Function, Linguistic Systems, and the Arts

Armed with a general constructivist approach to psychological phenomena, we have taken a fresh look at some of the issues raised by the theory of symbols. In particular we are interested in whether the logical distinctions and the formal systematization have psychological significance, whether they are independent of, confirmed by, or even inconsistent with data on how individuals process information and operate with symbols. One of the broadest contrasts in the theory of symbols is that obtaining between linguistic and non-linguistic symbol systems. The Project has accordingly been especially interested in psychological evidence relevant to the way the human organism deals with these kinds of symbols. Intriguing observations have come from an unexpected source: research on the effects of various types of brain injury. In particular the research of Luria (1961), Sperry (1969), Geschwind (1965), and their colleagues has suggested that language and language-related functions are mediated by the left frontal and temporal regions of the brain (in right-handed persons) while extra-linguistic and non-linguistic functions (such as spatial, pictorial, and textural perception) appear to be mediated by the right posterior regions of the brain. Inpairments of linguistic functioning often occur after injury to the dominant hemisphere, while impairments of non-linguistic symbolic capacities follow injury to the non-dominant hemisphere.

Though the bulk of evidence on cortical specialization has come from case studies of brain-injured persons, techniques have recently been developed which allow investigations of hemispheric dominance in normal persons. In general these techniques pit the hemispheres against one another through a simultaneous or successive presentation of input to both ears or to both visual fields. Dominance is inferred from the relative speed, efficiency, priority, or superior recall of one or the other hemisphere. Details of these investigations need not concern us here, but it is worth noting that, whether the channel used is auditory or visual, linguistic input is more readily assimilated by the left hemisphere. On the other hand, if non-linguistic (e.g. "meaningless") visual or auditory material is presented to both hemispheres, the right hemisphere usually performs with greater rapidity and accuracy. With the adoption of sophisticated measurements of auditory capacity, it has been established that the left hemisphere is dominant for consonant sounds, BUT NOT for vowels and clicks. When musical selections are presented to both ears, and the subject's recollections of melodies is tested, the right hemisphere

emerges as more sensitive to such non-verbal auditory input.

Though these and other studies would appear to comprise unambiguous support for the linguistic-nonlinguistic dichotomy, so straightforward an analysis may not be correct. Howard Gardner, who is reviewing this literature, has pointed out that most of the studies can be interpreted as demonstrating that the left hemisphere is better able to handle familiar material, while the right hemisphere is better able to assimilate non-familiar material. Since language is so familiar to normal humans, it is exceedingly difficult to find other material that is equally familiar to this population and so a critical test between the linguistic and familiarity hypotheses is difficult to envision. There is the further possibility that linguistic systems by their very nature are concerned with perpetually familiar stimuli, which would make it impossible to disentangle these two factors. Finally, the apparent dominance of the right hemisphere for some musical functions presents a problem for the proposed analysis, since music (as practiced and perceived in the West) possesses characteristics of a linguistic system, though not of a verbal one. It is perhaps best to speak of tendencies: the dominant hemisphere seems to deal primarily with material that is verbal and familiar, while the minor hemisphere seems better equipped to deal with material that is non-verbal, unfamiliar, or in some way dense and undifferentiated.

A few other findings concerning division of labor between the hemispheres are worth noting. Semmes (1968) has proposed that information is encoded differently in the two hemispheres, focally in the left hemisphere (so that a discrete or "focal" lesion can completely destroy or completely spare a certain function) in a more diffuse fashion in the non-dominant hemisphere (so that a focal lesion will hardly ever destroy an ability entirely but may well lead to slight decrement in a range of activities). Such a difference between hemispheres might account for the relative superiority of the left hemisphere in handling discrete notational material and the relative superiority of the right hemisphere in handling diffuse, dense material, as well as aspects of spatial orientation and perception. Work by Sperry and Levy (1970) on patients with split brains (as a result of surgical separation of the corpus callosum) has revealed that subjects are better able to remember nonsense figures which can readily be described as words or decomposed into simple parts when these are presented to the left hemisphere, while they are better able to remember figures which are difficult to encode linguistically when these are presented to the right hemisphere. Proceeding from this and a number of other studies, Levy has suggested that the right hemisphere is better able to discern constancies in elaborate and difficult to encode stimuli such as faces, scrambled forms, and abstract patterns. Reviewing this information, Professor Goodman has proposed that perhaps the right hemisphere initially processes all unfamiliar information, but that as the information becomes familiar, it becomes transferred to and subsequently handled by the left hemisphere, a better organized filing system.

How do such observations bear upon the arts? We have remarked, half-seriously, that most contemporary education has a half-brained quality. So much of classroom time seems to be spent drawing only upon faculties and skills that the left hemisphere controls, with the consequence that the faculties of the right hemisphere appear to be under-exploited. And yet the crucial role in the arts played by the right hemisphere is suggested by

a number of findings, (Alajouanine, 1948). Most striking, perhaps, is the fact that musical perception and production appears to be affected more acutely by injury to the right hemisphere, than by corresponding injury to the left hemisphere. Indeed patients suffering from language impairments almost invariably sing much better than they can speak. Furthermore, studies of artists who have suffered from brain damage reveal that painters can sometimes have almost complete loss of linguistic capacities without their artistry being notably impaired (while right hemisphere damage impairs the ability to copy designs and to realize complex spatial configurations). Music and literary productivity do seem affected by injury to the speech area, even though in the case of music individual differences are great. In some cases, aspects of certain capacities involved in a given art form are impaired more by injury to the dominant hemisphere, while other skills involved in the same art form are more seriously impaired by the opposite lesion. For example when a subject attempts to duplicate a model by drawing, the left hemisphere appears to perform an analytic function, breaking the model into its parts and making sure that all are included, while the right hemisphere is more sensitive to overall spatial and Gestalt properties, such as sizes, orientations, and the relation between parts. Perhaps, then, it would be more accurate to say that artistic capacities — particularly music and painting — draw upon both hemispheres and that injury to either hemisphere may impair the artist's productivity or, alternatively, give it a peculiar (though not necessarily an inferior) cast. Artistic comprehension and production would presumably be enhanced to th extent that capacities mediated by each hemisphere are developed to the fullest; perhaps, indeed, after injury the spared hemisphere could take over certain functions, perhaps by employing different mechanisms or pathways.

Several other topics have been investigated in conjunction with our explorations of brain damage. Here we will briefly mention a few of them, stressing their possible relevance to questions involved in artistic perception and production.

a) Reading. We have considered the nature of various types of reading. One might have thought that all types of reading were controlled by a single brain center. But studies of individuals with "pure alexia" reveal instead a relatively systematic order according to which reading ability breaks down (Benson and Geschwind, 1969). Many individuals who have no trouble recognizing pictures of objects or familiar symbols (like a Coke trademark or a USA emblem) may be unable to read the corresponding letters or words, in a neutral setting. And many of those who experience almost total failure with words are nonetheless able to read numbers. Finally, brain injuries which impair or destroy reading in a phonetic language may spare reading in patients whose language is pictographic. We have begun an investigation of such patients and are hopeful that a comprehensive theory about the acquisition of different kinds of reading, the processes required to decipher artistic and non-artistic symbols, and the relationship among the psychological capacities needed to work with numbers, words, and pictorial symbols may be forthcoming.

b) Impairments of memory: Starr (1970) has found that individuals with hippocampal damage who are unable to remember verbal material that was recently learned, can nonetheless learn to solve a complex maze or perform a piece on the piano, though even after a successful performance they will vehemently deny prior knowledge of the maze or the piece. This finding strongly supports the Project's hypothesis that verbal and motor skills are learned and stored in different ways by the human nervous system.

c) Eidetic imagery: We have interpreted the phenomenon of eidetic imagery (the capacity to remember a briefly viewed scene in detail at some later time) as a mixed blessing; on the one hand, the ability to recreate a visual scene may have value for an artist; on the other, such a faithful record is certainly uneconomical and may actually inhibit the development of new classifications, reformulations, or fresh views of a subject or scene. The linguistic description of a scene by an Eidetiker as he observes it is sufficient to prevent the formation of an eidetic image. Here, surely, is evidence that the linguistic system may compete with other ways of processing information. The finding that incidence of eidetic imagery is much higher among brain-injured individuals confirms the bizarre nature of this capacity (cf. Haber, 1964).

d) Coding: Studies of verbal or linguistic encoding of various stimuli have again revealed that language may be used in a positive or negative way (Brown, 1956). When a subject is presented with an ambiguous stimulus to remember, the label that he applies to it may well lead to systematic distortions; here an ordinary subject is at a disadvantage compared to the Eidetiker. Individuals whose figural perception has been impaired have sometimes proved extremely sensitive to textural aspects of stimuli; again we find that failure to encode may be advantageous. On the other hand, while the capacity to remember faces in a rogue's gallery is extremely difficult for the Eidetiker (who can "image" more familiar Gestalten like animals and objects but not - except in rare cases - extremely fine details in a face), an adroit user of language may be able to select an appropriate synthetic verbal encoding (like "pert" or "Micawberesque") which enables him to remember a particular face from a very large group. The beneficent and maladaptive use of linguistic coding and processes would appear to be a crucial aspect of artistic education and production.

All told, we have found the area of brain damage to be a fruitful source of evidence on the nature of skills, the way they are acquired, the manner in which they operate together, the course of their disintegration. In particular, the sparing of a skill in isolation from others (such as the ability to read numbers but not words) or the destruction of two apparently independent skills by a single lesion (the

ability to perform complex spatial manipulations and the capacity to understand logical-grammatical commands) can provide a powerful means for testing theories about the identity or distinctiveness of two psychological processes, or about the sort of relationship between processes that may facilitate or inhibit transfer of training from one to the other. Such information is obviously extremely important for designing or evaluating educational procedures. The extreme complexity of such skills as reading and writing is impressive and certainly processes involved in the arts are at least as intricate and complicated; we do not expect to find an artistic center anterior to the pineal gland. But we do feel that further investigation of skill composition and breakdown may contain powerful clues about the nature of artistic education and participation. These studies should complement well our investigation of ongoing artistic activity reported in coming chapters.

CHAPTER 4. THE PERCEPTION OF MUSIC AND PICTURES

The perceptual functions of man are inevitable participants in the creation and comprehension of art. Certainly to a large extent and perceiver of art utilizes the sensory apparatus and skills common to the broad range of human enterprise. But it seems almost sure that the fullest facility with particular art forms depends on particular perceptual skills attuned to those forms. Thus the Project has been led to explore those aspects of perception which seem highlighted by various arts, and to consider the extent in which the processes involved seem common property of us all, or require special talent or training.

Our principal studies of perception have concerned music (particularly rhythm) and the pictorial arts. That the literary arts are so little represented signifies no designed omission. The literary arts have played their part in our arts orientation program (section 7.3.1) and in research pursued in the Project Zero course (section 7.3.3); other particular investigations in this area are planned for the future. In this chapter we will review a variety of studies concerned with the perceiver's relationship to a musical or pictorial work, focusing in particular on works within a given symbol system. Those of our psychological studies which are directed at a range of symbol systems, and which are concerned with the usefulness of certain general analytical approaches to the arts, will be discussed in the following chapter.

1. Studies of Music

1.1 An Approach to the Perception of Music

Jeanne Bamberger has been analyzing the nature of the perception of music and how such perception develops, in order to draw implications for music education. She suggests that current music education may implicitly impose on students inappropriate or artificial perceptual categories. For instance, characteristic of the novice listener are discriminations of a rather general sort such as faster, slower, louder, more instruments, new tune. That is, perceived entities and structures are gross configurations, combinations of what music students are taught to isolate and identify: pitch, duration, interval, chord, texture. The question arises, what is the effect of such isolating and identifying procedures on the more global kind of hearing; in what way do they influence perceived entities and relationships?

This question reflects a general view of perception as not simply a passive talking in a stimulus, but an active organizing process in which the listener discovers or constructs his own coherence by spontaneously and/or deliberately coding the stimulus (not necessarily verbally) through various implicit means which can be described as categorical systems or languages. Thus, the perception of music varies as a listener's available categorical systems lead him to seize on different aspects of the stimulus and also according to the degree to which the listener can process multi-dimensional relationships.
Examples of this are evident. A work (say an Indian Raga or a work of

Webern) may be utterly incoherent for a listener because he lacks appropriate categories. The Western listener carries with him perceptual categories that we lump together as tonality, and compositions which function in these terms will at least "make sense". But even here the listener's response -- that which he perceives -- will depend on the limits of his capability for processing relationships within and across various dimensions and his degree of mobility of focus.

The example of tonal harmony provides an opportunity to emphasize that indeed musical perception may be described in terms of an individual's categories for grouping stimuli both on the fragmentary level and on a level where these fragments cohere into a larger structural unity. For example, the identical chord, in terms of pitches, can fulfill entirely different harmonic or structural roles depending on the surrounding context. While a set of chords may establish or confirm a prevailing tonality, in isolation a chord can have only a potential for particular functions within various tonalities and thereby only a potential significance in a given work -- indeed it can shift its rank in the tonal hierarchy at any moment, as in modulation.

The listener's system of categories is influenced by the uses to which the individual puts the piece. For example, there are various verbal systems (vocabularies) and these tend to reflect the interests of the various users: a work or a fragment of a work may be heard and classified as in the style of some period -- Baroque, Romantic; in the style of a composer; with regard to form -- rondo, sonata, waltz; in terms of dominant instrumentation -- orchestra, quartet, piano, and so on. The conventions of music theory permit closer analysis in terms of upbeats, dominants, "simultaneities", modulations, sequences, inversions. Finally a particular piece of music may, so to speak, propose and develop some system of its own. Indeed, a critical question is: how does the perception of (and descriptive language for) a unique work make use of, depend on, assume, or ignore, the various conventional vocabularies cited?

Here it must be recognized that a learned system of verbal categories will influence, and even sometimes generate, the perceptual categories of the individual. Thus, for example, a 16th century work that an editor had notated in a regular duple meter was, in fact, heard in duple meter by the student looker-listeners. When notated without bar lines, the work was (properly) heard by the same students as ametric, with pulses grouped irregularly in fours, threes, fives, etc. There is no intent to suggest that the hearer is necessarily limited to the word-categories available to him. But an untutored listener may, with experience, naturally develop different categories, and thus perceive a piece quite differently from the conventionally trained listener.

The novice, it was earlier remarked, will probably perceive in terms of rather superficial features such as speed, volume, "the tune", instrumentation. He will thus be most responsive to works where significant coherence is limited to such elements -- for example, "pop" tunes, marches, or works where "development" consists primarily in re-orchestration. On the other hand, the novice is at least potentially freer to discover the unique process of a particular work, exactly because he is not locked into the notations or codifiers of convention. It may be possible to lead an

individual's categorical system to develop naturally through a process of first learning (making conscious) the cognitive-sensory categories implicit in his perception of relatively limited and "surface" configurations ("the music gets higher", "there's a new sound"). The student might then move towards the discovery of new cognitive-sensory categories characterized by a greater articulation of musical attributes, the capacity for a greater mobility of focus and a higher degree of relational perception. Such a sequence could hopefully be organized so that the listener meets each work of music in a plastic manner and acquired categories become not commitments, but tools of perception and comprehension to be used where appropriate.

The usefulness of a "categories" approach is exemplified by following sections on pitch conservation in children, children's perception of rhythm, learning rhythm notation, and a notation for rhythm perception. Furthermore, the same sort of characterization proves useful in several other areas of this report, for example in the discussion of the perception of pictures, section 4.2.1.3, in a study of caricatures and recognition, section 4.2.3, and in style perception in music, section 5.1.1.3. The progression from global to more articulate perception of music is well demonstrated by the experimental investigations of rhythm described in sections 4.1.3.1 and 4.1.3.2. A text by Jeanne Bamberger and Howard Brofsky (1969) illustrates how this progression can be utilized in instruction.

1.2 Pitch Conservation in Children

An area in which general trends of musical development are illustrated is that of conservation of pitch. Before "conservation" of various properties has developed (cf. Piaget et. al, 1965) children have difficulty recognizing that a pitch is not necessarily tied to the object that makes it, nor to its "geographical" location in a series. Bamberger has investigated this phenomenon in a simple experimental situation. Five bells, all of which look identical in size and shape, are set in a row, and each child is given a hammer to play them. The bells are arranged and played in the order C E G G C; this, he is told, is the song. After hearing and playing the song several times, he is asked if any of the bells "sound the same" -- i.e., have the same pitch. Two separate pairs of matched bells are used to demonstrate what "sounds the same" means. Most children are able to find at least one pair of bells which sound the same -- usually, the two Cs. They are then told that the song can be played with just four bells, and are invited to do so.

Twelve children were tested, ranging in age from 5 to 8. All but one eight year old (and she was identified as "very slow"), could play the song after the last bell had been removed. Typically, the 5, 6, and 7-year-olds played C E G G and then looked up with a puzzled expression. Most could play the tune with only four bells after this was demonstrated. The 5-year-old was unable to play the C bell twice, even after being shown. Except for one 7-year-old, those that played the tune with four bells after being shown, could not by themselves go on to play it with three bells (the extra G removed). After being shown, they could do so, and all but one could say that while there were five bells, there were only three sounds. Most singled out the E as "different" -- "It's a dumbbell", "It's an oddball".

This study suggests that early music education must take into account the child's development of concepts of pitch. The instructional techniques normally used tend to reflect the perceptual habits of the adult; the world of the child can be decisively different. Although able to find matching pitches in the song, most of the younger children could not infer from that a new procedure for performing the piece. Both the development of relevant concepts (Piaget, 1963) and the interrelation between competence in comprehension and competence in performance need careful examination.

1.3 Rhythm

Since the remaining sections on musical perception deal with particular aspects of rhythm perception, it seems worthwhile to preface these with a few general remarks. Rhythm has been a subject of special interest to Project Zero because of its broad cross-medial and cross-modal relevance. Rhythmic phenomena occur throughout the arts and also appear to play a fundamental role in the organization of human behavior (Neisser, 1967). Most obviously, of course, rhythm is important to music, dance, and poetry. However, one can see or feel rhythms as well as hear them and moreover it is common to speak of the rhythm of speech, the rhythm of prose or poetry, rhythm in films, or even the rhythm of a painting. To dismiss such usages as 'merely metaphoric' would be to miss investigating the basis of the metaphor, the reason for its appropriateness.

The human organism exhibits a number of natural rhythms such as the alpha rhythm of the brain, pulse, breathing, and, in the infant, sucking rhythms. There is some reason to believe that complex motor performances and other ordered tasks find part of their origin in the simple organizing rhythms of the infant, and differentiate out of them (Wolff, 1967). Inability to perform smoothly simple rhythmic tasks such as tapping with a pencil is often found associated with reading and speech problems and other difficulties involving coordination.

While pondering through readings, and discussing the breadth of rhythmic phenomena, we have, for a start, conducted specific research projects mostly in the context of music. Two themes have dominated this work: one of assessing human capacities in recognizing, reproducing and creating rhythms, and of assessing how such capacities relate to musicianship, dancing, and like disciplines; the other of unravelling conceptual confusions and attempting to define clearly what it is to perceive or produce a rhythm. Clearly these two themes are partners in an effort that could come to little without the participation of both. While we certainly have barely commenced to explore them, we have advanced on the one hand to conducting several experiments and on the other to developing a "notation" for rhythm perception in music (section 4.1.3.4) which offers a tentative resolution of some theoretical issues.

1.3.1 Children's Inventions of Rhythm Notations

The themes developed in general terms in the previous section and in section 4.1.1 gather specific content through a study by Jeanne Bamberger of children's grasp of rhythm and children's inventions of ways of symbolizing rhythm. For brevity, we speak here of "notations" -- but many of these ways

of symbolizing are obviously not notations in the technical sense defined in the theory of symbols (see 2.1 above). The research spanned a period of six months at the Happy Hollow Elementary School in Wayland, Massachusetts. The study was relatively unstructured because little was known about the area and Bamberger was searching for promising hypotheses. However, one assumption held throughout: musical activity, like any other human enterprise, involves an individual constructing his own perceptual coherences and actively organizing his responses. One aim of this work was to map a range of responses to a rhythmic stimulus reflecting anything from a relatively and discriminating global reaction to the stimulus to rather fine judgments about component parts and their relation to the whole (cf. Werner, 1948).

Children in grades 2 through 6 heard a set of six brief rhythmic configurations. Each rhythm was played on a drum several times by the music teacher. The children were asked to clap the pattern. When the teacher was satisfied that most could play the pattern correctly, she said "Now draw a picture of your claps so we can remember it next week or so someone else could clap it". After the 4th, 5th and 6th examples, children were also asked to "put in numbers where they seem to fit" on their drawing efforts. These highly unspecific instructions were intended to lead the children into the task, while leaving them quite free to invent their own approach to it.

In coping with the assignment, the children adapted four discrete strategies which may well reflect different developmental stages of cognitive growth. Level 1: pictures of houses, cars, designs, or anything, with no apparent relation to the stimulus. For these children, the task was evidently irrelevant, incomprehensible, or both. Level 1 responses were rare in this study. Level 2: chains of things like events in time but with no obvious relation to the events in the stimulus; random squiggles, often in rows, like rivers, roads, or electrocardiograms. Level 3: strings of shapes and/or colors ordered so as to represent the temporal sequence and number of events in the stimulus. For example, ♩♩♩♩♩♩♩♩♩ might be drawn as ●●●●●●●●● or ∧∧∧∧ . Level 4: chains correct in number of items and also indicating some grouping of items reflecting one of two organizing principles described later.

In the course of the study, about 200 drawings were collected. Children 6 to 8 years old frequently performed on levels 1, 2 or 3. Most of the older children, 9 - 12, performed on levels 3 or 4. In second grade classes, for example, half of the children were at levels 2 or 3 and half at 4. In the sixth grade, nearly all children were at level 4. Lower level performers among the older children were often identified as poor readers. This finding obviously invites more exploration, particularly as it relates to other studies involving reading difficulties and the matching of visual-auditory series (e.g., Goodnow, 1971).

At the fourth level, the drawings exhibited two distinct kinds of grouping strategies, "configurational" or "durational". One rhythm from the set of six will serve to illustrate the strategies. Figure 1 gives the played rhythm and three typical drawings.

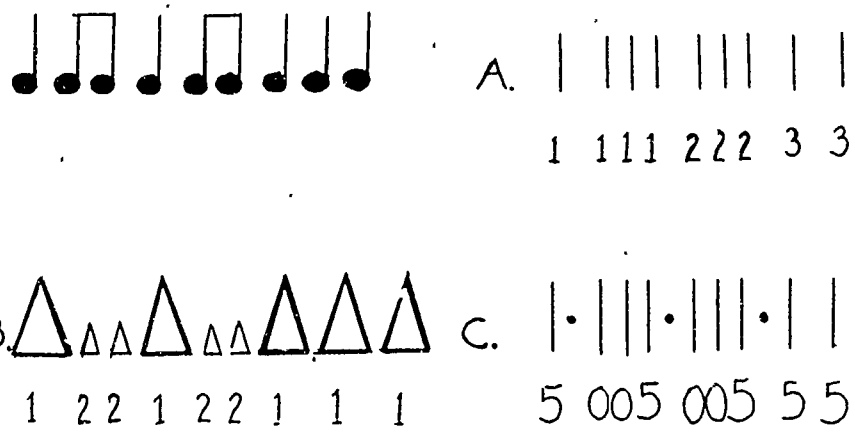


Figure 1

Configurational grouping is characterized by the child indicating sequential clusters of taps, often in relation to a stop (i.e. a longer interval of silence) in the motion of the rhythmic sequence. These groups may correspond to "clustering" in the rhythm notation of section 4.1.3.4 "A" is a characteristic example. In durational grouping, the child classifies the claps according to their "length", i.e. duration until the next clap. "B" is an example. However, this classification represents no measure of the exact relative duration of the claps; the sequence ♩♫♩.♬♩♩♩ was pictured much the same. Example C is of particular interest, as it was the only case where a child used both grouping strategies at once. The separation of the vertical bars indicating taps by dots gives a configurational grouping. But the numbers written under the tap bars indicate a durational grouping. Whether or not these children would be able to move on to a more formal and standardized system of notating duration was explored in the following study.

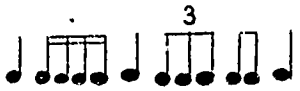
1.3.2 Teaching Children Rhythm Notation

The above description provided a characterization of the children's untrained response when asked to draw rhythms. Bamberger explored means to lead the child to a more systematic scheme of notating rhythmic passages. In normal music notation, all durations are measured against a constant unit, the "beat" and all taps are located against the underlying grid of this recurring beat. Hearing the taps of a piece in relation to that underlying beat is a critical aspect of rhythm perception. The drawing method described above provided means to demonstrate to children this coordination between beat and rhythmic pattern.

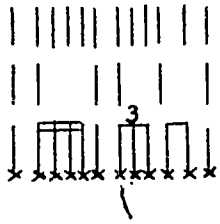
Children were asked to work in pairs. One child moved a paper slowly across his desk while the other tapped with a pencil at one steady spot (relative to the desk) so that he left a series of equidistant dots across the page. If the child "played" faster, the dots grew closer. Next,

children were asked to play first a steady beat and then, starting again at the same place, and with the paper moving at the same rate, a rhythmic configuration given by the teacher. This yielded a visual representation of the rhythm and its organization relative to the beat.

Then, children were asked to draw the taps and beat of rhythmic sequences without using this method. One child of a pair would clap the rhythm, and the other the beat. Or when possible, a single child would manage both, one with his hands and the other with his feet. The children would draw the rhythmic pattern as in the previous section, and under it indicate the recurring beat, as they had seen it with the moving paper task described above. With some practice, and the learning of a few more conventions, fifth and sixth graders were soon able to notate, for example,



as



The exercise with the moving paper illustrating as it does the possible correlation between time in the music and space on the paper, was critical in leading the children to this level of accomplishment. Indeed, children below the fourth grade and even some in the fourth grade found it nearly impossible to coordinate beat and piece on paper without actually performing that physical operation. They were unable to reconstruct the relation between the beat and piece in a symbolic representation free from the sensory-motor activity. This seems a clear demonstration of what Piaget calls "centering" (1969). Apparently systematic rhythm notation is conceptually only accessible to children who are well into concrete operations.

The clear lesson in this is that it is a mistake to try to impose too early the principles implicit in standard rhythm notation. In the early elementary grades, children should probably direct their learning towards developing and refining sensory-motor activity, together with analysis and representation or reconstruction of these activities in durational and configurational ways of their own invention. In due time, and against this established background, more sophisticated notational schemes can be introduced. An essential caution there, however, is that learning the rules of a sophisticated durational notation should not defeat or repress the child's prior grasp of configurational grouping.

1.3.3 Children's Duplication of Rhythmic Patterns

In parallel with Bamberger's work described above, Gardner has conducted a preliminary experiment to assess the general ability of children to duplicate rhythmic patterns (1971a). Children aged 6, 8, and 11 years heard twenty different rhythmic patterns varying in number of blows (4-8) and in the arrangement of the blows (evenly spaced, groups of two, three, etc.). Each pattern was heard only once and the child was asked to duplicate it. It was determined that older children were able to handle a larger

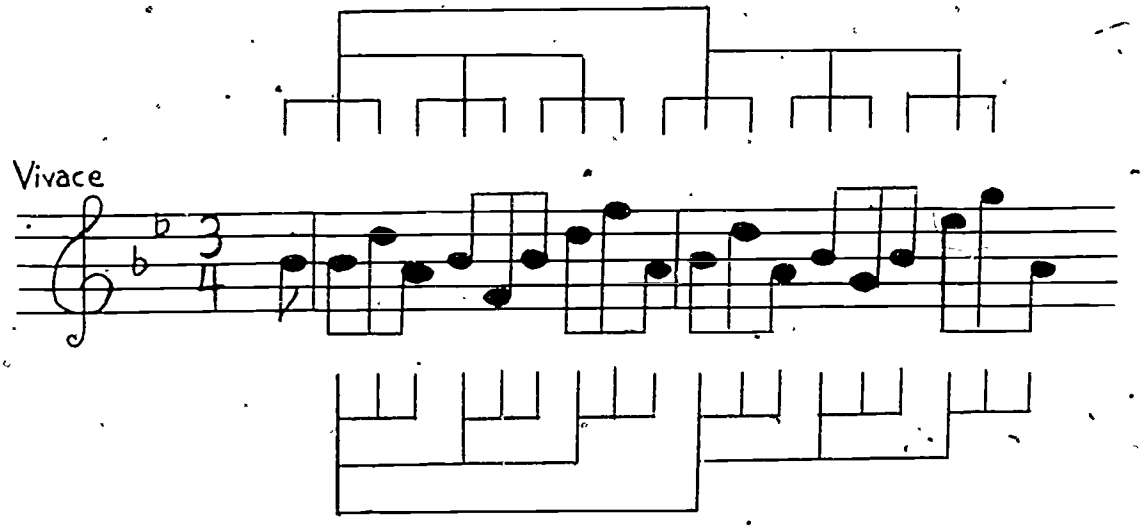
number of blows, with the sixth graders receiving nearly perfect scores, irrespective of the difficulty of the patterns; that the internal arrangement of the patterns as well as their number of components determined the difficulty of duplication; and that children at each age level improved in the task over the course of the half hour session, even though the later patterns contained more blows and were in no other way simpler than the earlier ones. Attempts have been made to relate the difficulty of the patterns to the amount of information contained within them and to devise a scoring system which would give some credit for "near misses" but neither of these analyses has been completed. A study of the rhythmic sensitivity of brain-damaged patients is also being contemplated. It is hoped that the errors made will provide clues as to the way in which normal subjects process rhythmic configurations.

1.3.4 A Notation for Rhythm Perception

Among other things, these various studies of rhythm perception have underlined the need for a rigorous definition of rhythm and a systematic way of symbolizing it. Responding to this need, David Perkins and Vernon Howard have devised a notation for certain aspects of rhythm in music ("notation" is still not here used in the technical sense of Chapter 2). The system is not prescriptive -- that is, does not specify what notes are to be played, as does conventional music notation. Rather its intent is to record the organization, structure, or orderliness that a listener perceives in a rhythmic stimulus.

They have distinguished two aspects of rhythm, "counting" and "clustering", and developed a notation for each. The most obvious example of counting is counting to music, as "one, two, three, four, one, two, three, four" to a march. This counting is merely an announcement of a usually silent process in which the listener organizes the sequence of notes into groups of equal time period, often corresponding to measures in the score. The counting process is not only a matter of grouping notes in measures. The measures may be perceived as combined into larger periodic groups, and these into larger yet, in a hierarchical manner. Counting is thus a generalization of the conventional musical concept of meter.

The other aspect of rhythm is termed "clustering". Short sequences of notes are heard as a cluster with one of them standing out as an accent, or "peak" in their terminology. The peaks of small clusters may be perceived as themselves members of larger containing clusters. Thus in clustering as in the case of counting, hierarchical organization occurs. The concept of clustering generalizes on the concepts "upbeats" and "downbeats". In introducing the terms "counting" and "clustering", Perkins and Howard have turned aside from the conventional terminology because (1) it does not recognize the generality of the phenomena involved (i.e., meter, upbeats are special cases), (2) it tends to be tied to the prescriptive nature of scores, rather than reporting psychological events, and (3) different authors use the conventional terms in different ways.



Courante from J. S. Bach, Partita No. 1 for piano

Figure 1.

Figure 1 illustrates the two notations on a simple example. The clustering structure is designated above the line. The stems emerging from the tops of the brackets indicate peaks and stems may be joined as shown into new brackets to indicate higher level structures. The counting notation appears below the score. A particular score or piece of music is generally somewhat rhythmically ambiguous; i.e. the clustering and counting patterns heard may differ from presentation to presentation; the example represents a possible hearing of the fragment.

Cooper and Myer, in their book, The Rhythmic Structure of Music, (1960) have effectively used a notation for what amounts to clustering (but somewhat more limited) for musicological analysis. This is not the major aim here. The notation reported is a step toward a psychological theory of rhythm perception. Experiments in which subjects match, identify, tap back, or transform and tap back rhythms presented to them can be described and analyzed by operations formally defined in terms of the notation. This new tool will facilitate planning of new studies and aid in the analysis of the studies of rhythm perception described earlier.

1.3.5 Fundamental Questions About the Concept of Rhythm

In earlier years of the Project, some fundamental questions about rhythm and related concepts were raised and discussed by Nelson Goodman, and subsequently by Geoffrey Hellman in a progress report of December 20, 1967. Opportunity to continue this work has since been lacking, but the following sample questions may be noted.

1. What formal features distinguish rhythm from other temporal patterns, such as melodies?
2. Most recognized rhythms are binary, representable by a pattern of zeros and ones. What of ternary (etc.) patterns? Is there a limit beyond which there cease to be rhythms?
3. Most recognized poetic rhythms are singly accented. What of multiply accented rhythms?
4. What are the limits of variation within identity of rhythm? Is the dual of a rhythm a different rhythm? Can rhythmic identity depend upon relative rather than quantitative features?
5. Can rhythm consist of variations in a continuous sound?
6. How are subjective and objective rhythm related?

Technological educational investigations of rhythm need not wait upon the answers to such questions but may be informed by and may inform such theoretical studies.

2. The Perception of Pictures

The Project's work on the perception of music has been conducted in parallel with a research program on the perception of various kinds of pictures, ranging in kind from simple line drawings to paintings, caricatures, and even displays perceived through touch. We have sought principles which will characterize all manner of pictorial perception, even as we have attempted to remain sensitive to the particular characteristics of a given medium and a given subject. Since most pictorial systems are "dense" or "replete", (Chapter 2) these investigations form an instructive complement to investigations of symbol systems of a more linguistic nature that are found in music, and of course in the linguistic arts themselves.

2.1 Geometry and Picture Perception

Skills in the perceiving of pictures play an essential, but largely unrecognized, role in the effectiveness of art forms such as painting, etching, photography, cinema, and so on. At first thought, there seems to be no problem. Seeing pictures is like seeing the "real thing". But the inadequacy of this formulation becomes apparent when one considers the numerous ways in which seeing the picture in fact differs considerably from seeing the real thing. Hues in picture and subject are rarely just the same, and indeed the picture may be black and white, or merely a line drawing. The rules of perspective may not be observed; indeed contrary rules may be followed as in the "reverse perspective" of many Oriental and Byzantine works (J. J. Gibson, 1971; Goodman, 1971). Even if the rules of perspective are observed, the viewer rarely finds himself so placed in front of the picture that the rays of light from it strike his eye at the same angles as would those from the original scene. Clearly, some of the same processes involved in interpreting real scenes also function in interpreting pictures. But to say that the two processes are one and the same is a drastic oversimplification.

With this issue in mind, the study of the perception of line drawings becomes particularly interesting. Various cues of depth, available in real scenes, and sometimes in more elaborate depictions, are absent from such drawings; missing are cues such as stereo, shading, texture, and even sometimes, it must be said, familiarity of particular space forms. Familiarity cannot generally apply, since it is easy to devise figures representing perfectly well forms the viewer has never seen before. The general consequence of this poverty is that any line drawing is extremely ambiguous from a geometric standpoint. There are innumerable arrangements of space forms with edges which might appear, if viewed from the proper location, coincident with the lines of the drawing. But the viewer's impression is typically of one distinct scene, or of a few alternatives, as in the shifting Necker cube. Since the information by which one alternative is selected out of an infinite range is not in the picture, it must be in the person. Then what principles of selection does he bring to bear? To what extent are these principles exercised in the viewing of real scenes? Recent research by David Perkins has addressed these questions, yielding some hypotheses and tentative conclusions summarized in the next three sections.

2.1.1 Cubic Corners

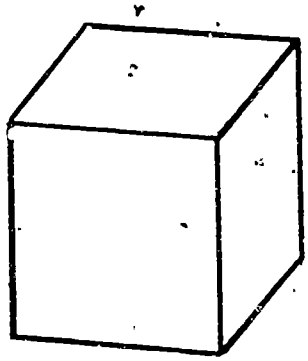


Figure 1

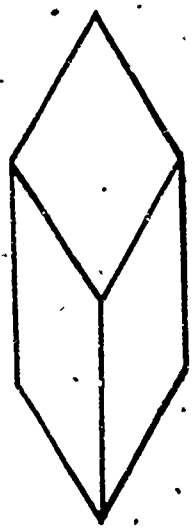


Figure 2

A notable feature of many line drawings is the dominance of rectilinear forms — boxes, buildings, street layouts, etc. In view of the ambiguity of line drawings, mentioned above, this rectilinearity is clearly the contribution of the viewer. The tendency to interpret corners as "cubic" may be a product of our carpentered civilization, but culture-bound or not, it seems a real and powerful trend. For example, figure 1 certainly seems rectilinear, but figure 2 not at all. Then what sorts of corners will appear to be rectilinear, and why just these?

Perkins performed informal experiments with a number of drawings to determine the range of three ray vertices which people are able to see as cubic corners (1968). This range is: if the two smaller angles are a and b, then either a + b is greater than or equal to 90 degrees and a is less than or equal to 90 degrees and b is less than or equal to 90 degrees or all three angles are each greater than or equal to 90 degrees.

The range of angles which geometrically could be projections of cubic corners can be determined mathematically. The condition is the same as above, except that no angle can equal 90 degrees, so "greater than" replaces "greater than or equal", etc. Thus the two ranges agree except for certain borderline cases.

Now in progress is an experiment to determine the accuracy with which subjects discriminate between corners that geometrically can or cannot be cubic. A deck of 128 cards was prepared, representing parallelopipeds (as in figures 1 and 2) of 16 angles and in 8 different orientations. After being shown that some figures of this sort look rectilinear and some do not, subjects are asked to sort the cards into rectilinear and non-rectilinear categories. Following the first sort, subjects can review their initial decisions once more. The results are charted and compared with the theoretical expectation. The data so far gathered show that all subjects exhibit some sensitivity to the discrimination, and that some are much more accurate than others. Detailed results await the running of further subjects under the above-described paradigm, and under another paradigm testing the same discrimination.

2.1.2 Oblique Views of Pictures

Earlier it was emphasized that there are many differences between the viewing of real scenes and the viewing of pictures, differences often overlooked. To focus on one such, pictures are usually thought of as seen with the line of sight perpendicular to the plane of the picture; however in fact the viewer is often, and sometimes considerably, to one side. Such oblique viewpoints result in retinal images quite different from those yielded by perpendicular viewpoints. The question is: how does the visual system adjust to this variation? This is an aspect of the general problem of object constancy. Pirenne (1970) has studied obliqueness effects in the normal viewing of large pictures with strong perspective convergence. The human sensitivity to the geometric conditions for cubic corners provided Perkins with a tool to investigate off-side viewing of pictures.

There are at least three aspects to the viewer's adjustment. The first two are commonsensical, but the third, involving the cubic-corners phenomenon, is a surprise.

-"Indifference". Some judgments about a picture are completely independent of an oblique view because they depend on features of the picture not distorted by it. For example, a contour interrupting another in a "T" configuration often leads the viewer to judge that one object is behind another. This evidence of occlusion is independent of whether the picture is viewed perpendicularly or obliquely.

-"Continuity". Certain judgments of relative size vary continuously with the shape of the retinal image. Thus a slightly oblique viewpoint causes only a small change.

-"Compensation". Sometimes the visual system actively corrects for the oblique view. The cubic corners phenomenon provides an example. A pictured rectilinear form (satisfying the cubic corners condition when normally viewed) will from some oblique viewpoints project a foreshortened image not satisfying the condition. And from some oblique viewpoints, a pictured parallelepiped not normally satisfying the cubic corners condition will, as foreshortened, do so. The question is: can the viewer compensate for the oblique viewpoint and discriminate whether or not the picture should be interpreted as rectilinear, in spite of a possibly misleading foreshortening effect? Informal experimentation reveals that much of the time he can.

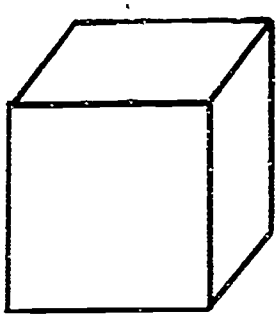


Figure 1

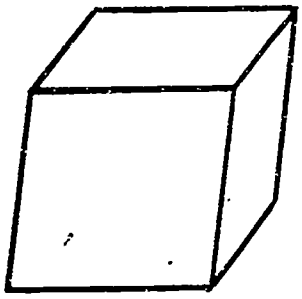


Figure 2

For example, figure 1, if viewed from the direction of the arrow at an angle of 30 degrees to the vertical, still appears to depict a rectilinear form. But figure 2, viewed perpendicularly, presents essentially the same retinal image as figure 1 viewed at 30 degrees. Figure 2 does not seem rectilinear and indeed, does not meet the cubic corners condition. Thus, with figure 1 viewed at a slant, the eye is not "fooled" by the foreshortened view and correctly interprets the picture as rectilinear. This sort of compensation is of particular interest, since it seems to be an adaptation specifically for the viewing of pictures. Only in oblique views of pictures are the lines representing a rectilinear form so distorted as to violate the geometric conditions for an image of such a form.

2.1.3 The Perception of Line Drawings of Simple Space Forms

The introduction to this section stressed the poverty of spatial cues in line drawings, and the consequent extreme ambiguity of such drawings from a logical standpoint. A theory of the perception of figures representing simple geometric forms must account for two phenomena: (1) the reduction in ambiguity, that is the selection of a few interpretations out of the infinite set of geometrically possible interpretations, and (2) the ambiguity that remains, the shifting among a few alternative interpretations in certain cases such as the Necker cube.

Perkins has proposed an account of the perception of such figures hinging on the observation that the space forms viewers see exhibit several types of geometrical regularities. For example, in both interpretations of the Necker cube, the form appears rectilinear, i.e. formed of edges meeting at right angles. A right angle between edges is thus one geometric constraint of interest. Other constraints which are sometimes relevant are symmetric equality of angles, as in an isosceles triangle, and parallelness and collinearity of edges in space.

Perkins' theory depends on a chosen set of such geometric constraints, and varying this set produces variations of the theory. Just the two relations right angle, and equal symmetric angles, permit accounting for the perception of a wide range of figures.

The theory roughly stated is simply this: given a figure composed of straight lines, the space interpretation made tends to be a space form which (1) has planar (not curved) surfaces (2) displays edges coinciding with the lines in the figure from the viewpoint of the observer, and (3) satisfies a geometrically maximal combination of constraints from the set of constraints. Some qualifications about perspective need to, and can, be made. Condition 3 is inevitably obscure in its condensation, and can best be explained by example:

Figure 1 may be seen either as solid or as a hollow half shell. Here only the solid interpretations will be discussed; the account of the hollow cases parallels that of the solid.

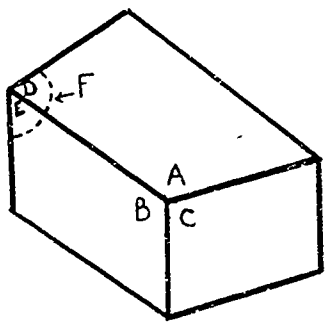


Figure 1

The figure is ambiguous, having three easily seen solid interpretations. These are, (1) the solid is box shaped at the near end; that is, angles A, B, and C are right angles; the far end is wedge shaped with D not right but obtuse, although F and E are right. (2) Just the reverse; the far end is box shaped with angles D, E and F right; the near end is wedge shaped with A obtuse, but C and B still right. (3) In this case the solid appears to be symmetric; angles A and D are obtuse and are equal to each other; both ends are wedge shaped, neither box shaped; angles C, B, E and F are right angles, as also in cases 1 and 2.

This outlines the perceptual situation. Now what is the geometric situation? The three alternative interpretations above have already been described in terms of three different sets of geometric constraints. Not only are these sets of constraints different, they are also geometrically incompatible. For example, if the nearer end is boxlike (case 1), the further end cannot be boxlike, for if A is a right angle D cannot be. Similar arguments show that the constraints of 1 and 3 are incompatible, as well as those of 2 and 3.

Furthermore, each of these three sets of constraints is <u>maximal</u> in a certain sense. In interpretation 1, the requirement that A, B and C are all right angles in fact mathematically determines the orientation of that corner in space (Perkins, 1968). This in turn, together with conditions 1 and 2 of the theory determines the orientation and shape of the entire space form. Thus no further constraints from the list, <u>not already implied</u>, can

be required. To put it another way, if an additional constraint not already implied were required, there would be no space form meeting all the conditions. In just the same sense, the constraints for interpretation 2 and interpretation 3 are also maximal.

One further point. In fact, the three sets of maximal constraints for interpretations 1, 2 and 3 represent the only three maximal sets for this figure.

Thus, the conclusions are two. First, the perceptual selection from the utter ambiguity of the figure is accounted for by the imposition of various maximal sets of constraints. Secondly, the remaining ambiguity, the three alternatives seen, corresponds to all the alternative maximal sets of constraints.

Perkins has analyzed a number of other figures in a similar manner, in a paper under the above title (1971b). There he also points out that triangles are typically perceived with less-than-maximal constraints, and that some "impossible" figures are perceived as more-than-maximally constrained. A current aim is to expand and adjust the theory and general approach to account for these instances and others like them.

The relationship of this research to aesthetic perception becomes manifest when one considers that the ability to gather three dimensional information from the flat surface of a picture is central to the perception of representational art and pictures in general. In an age stressing visual communication and education, this key interpretive process merits intensive study, and the work on picture perception and geometry described in this and prior sections provides a new avenue of approach. As this research continues, some of its potential implications and applications appear on the horizon. First of all, the approach offers a new platform from which to investigate differential abilities in the "reading" of pictures, the acquisition or emergence of such abilities, and their training. Second, the theory could provide a new conceptual tool in terms of which to trace the development of Western representational art, as well as the art of other cultures. A third result might be drawing techniques analogous to the laws of perspective, techniques which could be used, deliberately flouted, or ignored by an artist according to his needs.

2.2 Haptic Pictures

An enduring concern of our research has been the means by which pictures deliver information to the viewer. The presupposition implicit in that term "viewer" eventually prompted the question: were the eyes the necessary route of delivery? John Kennedy conducted a brief investigation of "haptic" pictures, pictures intended to be read by touch. Besides clarifying an issue of basic psychology (cf. Lowenfeld, 1947), this and like studies suggest a means of picturing helpful to the blind. The blind do learn geometry from illustrated braille texts and also show some ability to "see" by means of a television-like mechanism translating images into patterns of tactile

stimulation on the back. These are hints that one might build on haptic skills a capacity to deal with quite sophisticated representations.

Recently plastic sheets have been devised that yield distinct raised lines when depressed with ball point pens into a slightly yielding rubber surface. These materials intended for use of the blind, made a brief study of haptic pictures particularly convenient.

Two questions were addressed. (1) Can an unpracticed subject determine the shape of such Euclidean standard forms as a circle, a square, a triangle, a straight line and a point, and will these forms be apparent whether made of continuous lines or simply indicated by dots at the corners? (2) Can an unpracticed subject determine the referent of outline pictures of simple objects? Initial answers were sought with 5 twelve year old sighted but blindfolded subjects. Eventually blind subjects will also be tested.

The answer to the first question seems to be an unqualified yes. All subjects identified more than 3/4 of the Euclidean forms whether they were line-drawn or dot figures. Several subjects identified all of the forms correctly on first guess. As an addendum a line drawn figure that was not a standard Euclidean form, and a dot-figure, also not a standard Euclidean form, were also given, with the subjects' task being simply to describe the location of the parts of the form. All subjects eventually succeeded at this task though some took five minutes and some only one minute at the task. Some subjects described the individual location of the dots and others reported the figure as though the dots were connected by imaginary lines.

The second question can be answered by a very conservative yes. All subjects identified at least one of the outline familiar forms, and some identified two. Eight figures were given. Four were outline "impressions". That is, the objects or parts of objects depicted would have resulted in a shape like the outline figure were they pressed lightly on a flat wax sheet. There was an outline of a flat fork and of a hand, for example. Other figures involved overlapping parts, where the rear parts would not appear in wax impression, as in the case of a table, or a three-quarters view of a face, or a round cup with a handle. Four of the figures were hand-size -- including the fork and the face. Four were much larger than hand size -- including the table and a flag and flagpole. All of the figures were immediately recognizable to sight; this was verified for the five subjects when the blindfold was removed.

The table, the three-quarters view of a head and face, and the hand were identified by various subjects. Thus size and overlap would not seem to be critical variables. But there is no suggestion that the solution is "immediately given". Most trials with a particular figure took all of the three minutes allowed to the subject, and few of the figures were identified at all.

In summary, this simple experiment demonstrated a limited ability to interpret haptic pictures in untrained subjects with normal visions. This whole area invites more extensive investigation. Just some of the issues which might be studied are: - What are the effects of training; what capacities

would the naive or trained blind person exhibit? Is there a difference in performance between persons blind from birth and those with some visual experience prior to blindness? How fine are the discriminations that can be made by these various groups -- e.g., is physiognomic recognition possible from haptic pictures? The small study reported here, and further investigations such as suggested, all speak to the general point that the eye is not the only channel for spatial information. Indeed, it seems highly likely that forms and objects are "represented" in the nervous system in such a way that recognition is not dependent upon a specific sense, but can succeed via spatial information -- or other sorts of information -- acquired through various means and modalities.

2.3 Caricature and Recognition

Our final investigation of picture perception concerns the art of caricature. A key step in a viewer's interpretation and enjoyment of this art form is recognition of the person represented; hence providing an identifiable caricature is an inexorable aim of the caricaturist, however otherwise he treats his subject. Though caricatures may be identified by many means, including outright labelling of the figures, interest here focuses on caricatures identifiable from the configuration of the face.

The portrait caricaturist is a natural experimenter, exploring distortions for the sake of satire, expression of personality, and so forth, while also meeting the need to deliver an identifiable image. His experiments provide clues concerning pattern recognition and in particular the face identification process. An enconomical hypothesis is that caricatures are recognized by essentially the same psychological mechanisms that mediate normal face identification. Accordingly, the caricaturist is seen as transforming the face in many ways while preserving and indeed accentuating physiognomic properties relevant to recognition. His selectivity reveals which properties are relevant.

Pursuing this theme, David Perkins examined caricatures by many artists of a prominent political figure. Treatments varied widely, but certain features recurred persistently. A thin, elongate nose, jowls, a particular configuration of the hairline, and a certain shaping of the jaw, were all represented - and generally exaggerated - in almost all caricatures examined that were recognizable as the subject. No such caricature exhibited less than three of these properties. Other features just as characteristic of the individual, for example eye brows peaking toward the outside, were rarely represented in caricatures, and with no apparent detriment to the likeness.

The problem remained to specify further the role these four features played in identification. Two questions were examined: 1) were these properties necessary for an identifiable caricature of the subject? 2) were these properties sufficient? Clearly no feature was strictly necessary, as one or the other was occasionally omitted in the samples. This matter was further explored by tracing caricatures and changing the characteristic shape of one or more of the four features, e.g., bobbing the nose, eliminating the jowls, etc. In all cases, changing one feature degraded the likeness. Changing all four features produced drawings looking nothing at all like

the subject. One sample caricature offered a readily recognized partial view of a face. This prompted viewing of caricatures with various parts obscured by a card. Masking any one of the four key features did not produce the same marked degradation of likeness as changing the feature. Not missing information, but counter-evidence, evidence contrary to the key features, had the greatest detrimental effect on identification.

For question 2, "sufficiency", counter-example drawings exhibiting all four features but bearing little resemblance to the subject were easily prepared. Inadequate professional efforts displaying all four properties were also discovered. In a casual experiment, discussing the properties assisted amateur efforts but did not guarantee success. These considerations suggested that a) the descriptions of the four properties were too loose, and b) that there were other key properties. A not too convex or concave profile appeared to be one of these.

These tentative findings naturally invite some generalizations about the face recognition process. But first certain cautions are in order. The analysis can be construed as an effort to identify some "distinctive features" involved in face recognition (E. J. Gibson, 1969). But use of physiognomic properties as a descriptive device for modeling recognition behavior does not imply that these properties have any autonomous identity "in the head". Different property descriptions might prove as apt a model. Also, the properties isolated may not be relevant to the recognition of other caricatures or persons, and the properties by which recognition behavior is best modeled may vary from culture to culture, or even somewhat from person to person.

Finally, it is important to be quite clear about the bearing of the evidence gathered on normal face recognition. That evidence indicates that certain physiognomic features of the subject are consistently represented in caricatures of the subject, and that these features are very important to the caricatures' recognition. However, artists learn from one another, and though styles of caricaturing the subject are quite diverse, there is bound to be a certain accumulation of conventionalized techniques. Then to what extent are the "key" properties conventionalized techniques, as opposed to being the rediscovery of each artist? And if the properties are conventions for the artists, to what extent have they become conventions for the audience as well, so that their importance to recognition is a product of specialized learning about caricatures of a particular individual rather than an extension of the normal face recognition process for that individual? Perkins' estimate is that caricature recognition "borrows" the normal face recognition process, and further investigations are planned on this matter.

With these points in mind, the identification of caricatures and perhaps normal faces may perhaps be characterized as a process of checking for certain properties. The properties probably do not include conditions of exact metric proportion. Many properties logically individuating are not in fact utilized. Possibly a relatively small number of properties is involved. The checking process may either fail to find evidence relative to a particular property, find evidence, or find contrary evidence.

A particular subject may be identified through only a few properties, with many failures to find evidence at all. But a few instances of counter-evidence will block recognition of the picture or real face as that subject, even with a great deal of positive evidence. Here, of course, there is room for judgments of degree - as in remarking that one person "looks a bit like" another.

This procedure is a somewhat weakened version of identifying an item through a logical conjunction of conditions: several positive findings may suffice to discriminate that item from other items, but one negative finding suffices to disprove that identification. The same logic appears to underlie this face recognition process, a process, however, which is cautious enough of circumstantial evidence or counter-evidence not to reject a hypothesis on the basis of just one negative finding.

Parallel to this work on recognition, some consideration has been given to the merit of caricature as a subject for art classes. Caricature seems especially appropriate in several respects. First of all, it is an intriguing and involving pursuit; enthusiasm should be high. Secondly, the art of caricature is not too difficult - much easier than portraiture for instance, but difficult enough to present a challenge. In a casual experiment, for example, discussion of the key properties mentioned above led to significant improvements in the "after" as compared to the "before" caricature efforts of a small audience.

Finally, in portrait caricature there is a minimal standard of success: recognizability. This can be set forth as a clear goal and a goal easily checked, by students exchanging their untitled efforts with neighboring students in the classroom, for example. Certainly there is endless room for variation and refinement beyond recognizability. But when standards of evaluation are such a persistent problem in arts education, even a minimal criterion in one subject area is a point of relief.

On the other hand, too much emphasis on identification of subject may divert attention from such other important qualities of picturing as design, expression, and representational revelation of subtle, often overlooked, aspects of a subject. Caricature accentuates the obvious; one may say, indeed, that caricature caricatures art.

With this study of caricature we conclude our summary of research on picture and music perception. The parallels and distinctions between the various researches are still being sorted out - but already a number of themes and approaches which cut across the various art forms have begun to emerge. Some of the avenues we have explored in our effort to arrive at a systematization of research on the arts will be dealt with in the next sections.

CHAPTER 5. FEATURES SHARED AMONG THE ARTS

As we have been conducting investigations of a specific art form, subject population, or skill, we have continuously sought concepts and approaches which might have relevance beyond an individual study, which might enable us to organize the extensive and expanding range of materials on human psychological processing and skills to which we have attended. At first, there was hope that one approach or term - the arts as symbol systems, the arts as pattern recognition - might prove the organizing keystone for our work; but as discussion and investigation continued, it became apparent that there was no royal road to a psychology or education of arts -- indeed a multiplicity of viewpoints might be as desirable as it was inevitable. Nonetheless a number of the approaches considered have proved quite useful, at least as heuristic devices, in making connections between disparate parts of our research program. Certain of these approaches have already been discussed in other contexts - the theory of symbols, Chapter 2, an approach to the perception of music which has bearing on other arts as well, Section 4.1.1, rhythm, Section 4.1.3. Some approaches have already led to experimental investigations; others have suggested experiments which remain to be carried out and still others are currently frank speculation.

We will begin by describing some experiments directed toward analyzing the way behavior is organized by a subject as he comes in contact with an art object. Though these studies (of necessity) deal with specific artistic media, our principal interest is in their implications for perception and production across disparate art forms. In this spirit we look at the prerequisites for style and perception, the characteristics of an initial encounter with an unfamiliar artistic medium, and the kind of motivation governing a subject's behavior as he explores obscure patterns. Following this account of experimental work, we outline a number of concepts which have proved useful in thinking of the artist and audience member's behavior. Included are a discussion of problem-solving in the arts, the nature of search strategies and pathologies of problem-solving, the effects of various kinds of media on artistic behavior, and a hypotheses about the nature of early artistic development. Throughout we are guided by a view of the artist or audience member as an individual with an arsenal of skills and strategies which he seeks to use in an appropriate and liberating way as he achieves perceptions and solves problems involving various symbol systems and media. Though some sections will raise more questions than they will answer, they will hopefully indicate the directions of thought we have been pursuing, the paths we have explored on the way, and the nature of the terrain that lies ahead.

1. Experimental Investigations

1.1 Investigations of Style

While the property of pitch is peculiar to the musical arts, color to the pictorial arts, certain other properties, such as rhythm, style, and expressiveness cut across the range of art forms. Such properties

are promising areas for investigation if one wishes to search for general principles which relate to more than one medium or symbol system. The perception of style in various art forms has proved a fruitful domain of study, since works of art are universally categorized according to style, skill at perceiving is generally considered a trait of the artistic connoisseur, and development of a distinctive and effective style is an important part of the artist's maturing. Investigation of skill at stylistic recognition also bypasses many of the problems associated with skill at recognizing aesthetic merit. While merit proves difficult to operationalize and is inevitably a culture-bound judgment, style can be operationalized satisfactorily as for instance the distinctive characteristics of an individual's artistic production, and style sensitivity as the ability to group together works done by the same artist. The styles of individual works, "schools", "genres", and "eras" in art are other routes to operationalizing style recognition, interesting in their own right.

Drawing upon these considerations, Howard Gardner decided to conduct a series of studies on the development of sensitivity to style in various artistic media.

He had found in preliminary investigations that young children had little evident sensitivity to stylistic properties of works; they did not speak of style and they treated works as if they were simply "pictures of objects" or "stories about people and events". This finding raised questions about the capacities needed to detect style (Gardner, 1971e) and the strategies used in exploring a work of art. The methods utilized to measure style sensitivity varied across media, both because of the specific characteristics of each medium, and because of Gardner's continuing attempts to improve experimental procedures. Nonetheless some general principles have emerged from the group of studies and these shed some light on the nature of an individual's contacts over time with artistic objects.

1.1.1 Sensitivity to Painting Style

Several experiments have been conducted by Howard Gardner on the style sensitivity of school children to paintings. In the first paradigm employed, a subject was presented with several examples of an artist's work and then asked to select the painting done by that artist from a group of several other paintings. The experimenter could suppress the influence of such features as subject matter, predominating color, and medium employed by making them uniform, or determine their influence by varying them.

In one version of this design, first, third, sixth, and ninth grade students were tested on twenty sets of paintings (Gardner, 1970a). In half of the sets of paintings, subject matter was either absent (five abstract paintings) or controlled (five portraits); in the other ten paintings subject matter was available as a miscue. On the test as a whole, the ninth graders scored significantly higher, missing an average of six out of twenty sets; students from lower grades missed an average

of fifty percent. However, item analysis revealed that the older subjects were doing better on just those items where subject matter was misleading, but not significantly better in the other cases. Thus to be sensitive to painting style, the child must among other things learn to overlook content. Given the generally good performance of the younger children, it was hypothesized that they might be trained on just this point and achieve a much earlier sensitivity to painting styles.

Having established that pre-adolescent children tend to sort paintings by their dominant figure rather than by their style, (Gardner and Gardner 1970a); Gardner modified his experimental procedures in order to determine the factors influencing style sensitivity. By inverting the painting arrays, so that subject matter was less prominent, or by removing the more deceptive standard items, he was able to demonstrate style sensitivity among sixth graders, age 11-12, who had previously tended to sort paintings by dominant figure. First graders' scores were not improved (Gardner, 1970b). This finding accords with theoretical notions that children on the verge of a developmental shift benefit most from simplification of a task (Langer, 1969).

For his dissertation (1971c) Gardner devised a training study addressing the above hypothesis, in which one group of second and fifth graders was systematically reinforced for sorting pictures according to painting styles - operationalized as grouping paintings by the same artist - while a matched group was reinforced for sorting pictures according to dominant figure or subject matter. At both age levels children trained on style improved dramatically in their capacity to sort by style; the tendency of the matched group to sort by figure was also strengthened.

Auxiliary tests and analyses revealed a number of interesting findings. Subjects at the fifth grade level were able to switch the basis of their sortings when so instructed; this finding suggested that the older subjects who were reinforced for grouping by figure were latently learning the style grouping as well, while the younger figure-trained subjects exhibited no such tendency. All younger subjects were given tests of concrete operational thought (Inhelder and Piaget, 1964); contrary to earlier hypotheses, no link between ability to sort by style and level of operational thought was found. This, together with results on two transfer of learning tests, suggested that style sensitivity is primarily dependent on a certain kind of perceptual capacity rather than on more complex forms of reasoning or abstract thought. In brief, the subject who is able to sort by style has succeeded in focussing on structural regularities that cut across figure and group (Gardner, 1972). The capacity to discern such features is perhaps available to very young children, perhaps indeed to various animal species; their major difficulty in style sorting results from their strong tendency to focus on subject matter or form to the exclusion of the subtler textural aspects.

Gardner is planning and carrying out studies to determine what features are most important to style perception.

1.1.2 Sensitivity to Literary Style

Gardner's experiment in literary style was designed to determine whether children absorbed the style of a story they were told (Gardner and Gardner, 1971). Two incompleted plots were recast in two radically different styles which varied systematically in a number of dimensions to produce colloquial,"jivy" and fairy tale flavors. An experimenter would tell one story in one style to a child, who would then retell it to another experimenter, adding his own ending. The second experimenter would then tell the child the other story in the opposite style to take back to the first experimenter. Judges evaluated transcripts of the child's story for style without knowing in which style the child heard the story.

This procedure was applied to 6, 8, 12 and 15-year-olds. On the average the 12-year-olds proved the best performers, having the greatest sensitivity to style as well as the keenest memory for details and the cleverest endings. The 15-year-olds had a tendency to rework material into their own style, to ignore details, and to make up appropriate but unimaginative endings. Possibly with the advent of formal mental operation (Inhelder and Piaget, 1958), the oldest subjects were attending more to content, meaning, and argument. At any rate, now that the developmental profile is known, the causes can be probed and perhaps methods developed for maintaining and nurturing the high performance of the 12-year-olds.

1.1.3 Sensitivity to Music Style

As part of his continuing investigations on style recognition, Gardner devised a task in which children's sensitivity to musical styles was probed (Gardner, 1971d). Subjects at each of five age levels (6, 8, 11, 14, 18-19) heard sixteen pairs of musical selections: A pair consisted of fifteen seconds of music, followed by a bell which lasted approximately one second, and then another fifteen seconds of music. Subjects were asked to indicate if they thought both halves of the pair came from the same piece of music (but possibly from different movements). In half of the cases pairs did come from the same piece of music, in the other eight cases they came from different pieces, which were selected on the basis of their date of composition. In order to determine whether sensitivity to figural aspects of a selection was as dominant in music as in other artistic realms, the pairs also varied on whether they included a voice: eight of the pairs were entirely instrumental; the other eight pairs contained a voice against an instrumental background in one part of the stimulus, a purely instrumental portion in the other half. It was hypothesized that general style sensitivity (the number of correct answers) would improve with age: that younger children would tend to base their answers on whether there was a dominant figure in one half of a stimulus which was absent in the other; that older subjects would be more

likely to consider pieces composed in the same era as by the same composer; and that an additional hearing of the selections would improve the scores.

The findings were as follows. Younger children did show a significant tendency to judge style by the presence of absence of a dominant figure (the voice) while older subjects did not. Older subjects were more sensitive to the period of composition than were the younger subjects. At neither age did subjects perform significantly better upon a second hearing of the music; boredom or fatigue seemed to be operative with the younger subjects who performed somewhat worse on the second hearing, while the oldest group showed a slight but non-significant improvement upon a second hearing.

Most instructive were the overall scores on style sensitivity. Sixth grade, ninth grade and college sophomore subjects all performed at approximately the same level, with the sixth graders (aged 11) having the highest scores. Reasons given by the subjects for the responses suggested that the younger subjects (grades 1-6) were approaching the task in a fundamentally different way from the older subjects. Older subjects, seem to begin with the knowledge of music history, genres, and devices and draw conclusions as to the similarity of the selections based on the agreement or disagreement of classificatory labels applied to the specimens. "That is if he describes both pieces as baroque, the subject will probably conclude they are from the same composition, but if he classifies them in alternative ways - beginning of a symphony; middle of an aria - he will say they are from different pieces. Younger subjects, while clearly attending closely to the stimulus, did not appear to use these mediating concepts: they rarely indicated that two selections "seemed alike" or "felt different". The results of the study suggest that the two approaches are equally successful but that the classificatory labels may sometimes blind the subject to certain aspects of the composition. Textural aspects appeared to be somewhat more accessible to young subjects in the realm of music than in the domain of paintings, perhaps simply because the concept of figure is less often appropriate in music.

Though many additional questions about perception must be investigated before the riddle of style sensitivity can be solved, the investigations thus far have yielded a number of important findings. Style sensitivity has been shown to be a skill which the child does not display spontaneously but which requires only limited training in order to be elicited. Furthermore style sensitivity is not a skill which simply improves with age. There is some evidence that pre-adolescents may have keener sensitivity to the nuances and finer aspects of stimuli than do adolescents, and that younger subjects may also approach the task in a fundamentally different way from older subjects, with the latter group operating from verbal characterizations of the work. Finally, the results

of the various studies underline the fact that textures or microstructural regularities are often implicit differentiation of styles. In other cases, of course, overall features of design or color-relationship may be primary clues. But in either case, the way the child learns to de-center from what have become to him the most salient aspects of a stimulus configuration (its figural or subject matter properties) in order to attend to less dominating but equally revealing properties of the stimulus may be viewed as a model of one kind of learning involved in dealing with the arts. For this reason, investigations of properties like style, which cut across the range of art forms, may tell us something about the nature of the learning process and the relationships among the arts.

1.2 Infants' Finger-Painting Strategies

Another line of investigation which deals with children's relationship to art objects has focused on initial contact with a new artistic medium exemplified by infants' first fingerpainting. John Kennedy made videotapes of infants exploring fingerpainting, and analyzed these in collaboration with E. Mueller of Boston University, and a Harvard student, J. Moscow. The aim was to conduct an "ethological" study (Eibl-Eibesfeldt, 1970): to provide fairly natural circumstances which allowed the infants to react in a varied way without the close constraints and channeling of much psychological experimentation and then to attempt to analyze patterns in their behavior.

Each session involved five infants. One of the infants appearing in the first tape was replaced by another in the second tape. For the first session the infants ranged from 13 to 15 months, and the second was taken two months later, with the new infant being 14 months old. These were the infants' first exposures to fingerpaints.

While there are individual differences in the rate at which the infants progress, all the infants show the same pattern of exploration. The infants begin by orienting to a coffee table surface (covered with smooth paper) to which the paint is applied in pools by the adult supervisor. The concentration of attention and level of interest is revealed by unaccustomed silence on the part of all the infants. In the next stage, the infants approach the table, sometimes resting their hands on unpainted surface, not in the fingerpaint itself. Next an infant will put the tips of a few fingers in the paint, watching intently all the while. One or two movements of one finger, typically the index finger, usually follow. Then more fingers are used and eventually the flat of the palm is applied. At about this time the infant begins to make cyclic motions, taking the paint towards and away from his body across the paper surface. Then two hands come into play, often moving in an arc with the body as the center of the arc. The movements become faster and larger, and with time there is often less of the riveted attention shown in the earlier stages. More of the arm was often used, and some children even apply their heads to the paint, or begin to apply the paint to their bodies with their hands, and put their painted hands to their mouths. In the second tape there are instances of standing on the paint and slipping feet in it.

Thus there is a well-defined sequence to the infants' behavior. The sequence unfolds from close observation to tiny cautious movements towards larger and larger movements. Generally, the behavior moves from minimal contact with the materials to more and more contact. The movements become larger, and the close attention wanes. We are not yet clear on the frequency of re-occurrence of small movements at the stages when large movements are being introduced. Certainly a small movement occasionally follows a large movement. Also, the second videotape shows the infants beginning not with the large movements they had completed in the first tape but with small movements again. Some infants progressed through the unfolding sequence faster than in the first tape and introduced even larger movements than were used in the first tape.

Paints are materials that are used in the uniquely human activi ies of making pictures and designs, and some of the motivational and other factors underlying the behavior sequence may be related to this consideration. Also, it seems plausible that to some extent a general strategy for investigating new situations is involved. An organism that explored its world with gross movements before fine movements would probably be killed long before an organism whose exploration began with minimal contact with any strange objects. The tapes perhaps record the use of a general strategy of the latter form. Our observations of exploratory behavior with arts media are continuing and there are plans to examine different materials and children of diverse ages in search of common behavioral patterns. We feel that an overall ethological orientation, together with description of the fine details of behavior and their patterning and with an effort to determine the adaptive value of the behavior, is a promising approach to understanding the child's initial relationship to various media, and indeed a promising approach to many other areas as well. We are also struck by the apparent irrelevance of most standard theories of learning and development to the detailed structuring of behavior observed in such initial-encounter learning situations.

2. Conceptual Studies

In the following sections (2.1 - 2.4), the percentage of rumination and tentative speculation runs high. Initial groping towards appropriate conceptual equipment for significant inquiry into our problems calls for canvassing observation, experience, and fancy for suggestions that may lead to the development of some firm and workable apparatus. Nothing here is offered as final, and what is offered may range from the banal to the impossible. The several different lines of thought are not integrated into any coherent whole. Yet just this sort of exploration and hunch - taking is a necessary preliminary to consequential experimentation.

2.1 Problem Solving and the Arts

One route to understanding how artist and audience function is to achieve some sort of langauge or model in terms of which their moment-to-moment behavior at work can be described. An analysis of behavior as a sequence of problem solving and planning activities seems to be most promising. Such an approach provides a healthy counterbalance to the stereotyped image of the artist's behavior as immediate and unstructured.

"Setting problems" is often proposed and used as a teaching device in arts education. Finally, success in creation and comprehension may depend as much on good management of problem solving as on creativity or on sound aesthetic judgment, and thus training in certain basic principles of problem solving could be highly beneficial.

This approach to artist and audience behavior generally prompts various objections. One such is that there is no nontrivial solution standard for assignments like "produce a painting", at least currently. Most any organization of pigments on a surface can count as a painting. The point is granted. To refer to the task of producing a painting as a problem calling for a plan of action is certainly only sometimes appropriate at best. But to stop with this level of usage is to overlook an entire realm: the moment-to-moment microstructure of the artist's behavior at work. For instance, the artist errs (by his own judgment) in an indelible medium; what should he do? Or he sees alternative ways to proceed. Which to select? The poet needs an adjective to modify "bougha", an example discussed at length by I. A. Richards (1960). How does he search for one? Problems and plans are so much a natural part of accomplishing anything that often one is little aware of them; nonetheless they are central features of the organization of the artist's behavior.

Another source of difficulty is that there are often objective standards to determine what kinds of solutions are acceptable to scientific problems, while this seems rarely so for artistic problems. But first of all, while there may be no reliable standards for general artistic merit, within a particular school or discipline or for various technical problems or phases of a work agreed-upon standards are common, and can provide a useful guide (see section 7.4). Furthermore, on closer inspection, one finds that there are often no objective standards in science; objective standards are found more in textbooks than in the creative frontiers of scientific practice. Finally, the artist has a subjective standard - his own aesthetic judgment. A problem is no less a problem because the standards for what constitutes a solution are subjective.

Another misconception is that problem solving tends to be viewed as an especially deliberative and analytical sort of behavior, inappropriate to art, where "intuition" is so essential. We do maintain that producing a work of art is often a much more deliberative activity than is generally thought. But further, problem solving is neither necessarily conscious nor necessarily non-intuitive. What makes problem solving behavior is simply a problem situation, and an effort, deliberate or not, conscious or not, to solve it.

Art education often concentrates on imbuing values or perceptual sensitivity. The first is often risky, the second certainly worthwhile But exclusive attention to these overlooks a major point: the student, particularly the secondary school student and above, already has far more judgment about what looks good and what does not than he has the power to produce something that satisfies his judgment. Certainly there are further important discriminations and judgments for him to learn, and also accomplishing a work of art may involve revision of originally conceived goals. But consider, for example, that a novice

attempting an accurate portrayal of the human form will probably see perfectly well that his production is "not right". And he does not know what to do about it. Worse, some ineffective efforts to touch it up with eraser and pencil will probably convince him soon enough that there is nothing he can do about it. And still worse, an instructor dealing with a large class may well implicitly agree, by not intervening but accepting this student's production as the limit of his abilities. Thus what should be treated as a problem, something to be solved, is treated by student and teacher as an inviolate limitation.

Urging the student to "be aggressive -- look for problems -- try harder" will do no more good than encouraging him to "be smarter". However, instruction and practice in techniques for specific problems, like those involved in drawing the human form, will equip him to deal with these problems and will help to convince him that aesthetic problems do have solutions. Moreover, he can be introduced to techniques of problem solving as a distinct discipline that may open up an entirely new aspect of the process of artistic production to him.

The argument so far has been phrased in very general terms. In effect, an approach has been proposed, and some simple arguments against it briefly rebutted. But the true argument for it must lie in the delineation of specific concepts and terms by means of which the artist's problem solving and planning behavior may be analyzed. A number of issues must be resolved. There are important definitional questions: what for example is a "problem"; what distinguishes a problem from a mere task such as digging a ditch, however arduous it may be? There is the persistent probing for contrasts and commonalities between the arts and the sciences: how do problems in the two realms compare? There is the question of what sorts of general problem solving strategies there are, and which of these bear particular relevance to the artist. Some of these issues and others as well are touched upon in the following sections.

2.1.1 Problem Solving in the Arts

If problem solving is admitted at all as a concept relevant to artistic activity, often there is an effort to draw a sharp black-and-white distinction between problem solving in the arts and problem solving in mathematics, physics and similarly rigorous sciences. Dramatic contrasts are always suspect. If there are differences, there are also important communalities, and a balanced view must admit of both. Recently Project member Howard Gardner has described two manners of problem solving that he argues, often, but not always, reflect differences between art and science (1971b). One type, conceptualization of relevant factors, is more prevalent in the sciences; the other, execution confirmed to a specific medium, is more prevalent in the arts.

In Gardner's view, conceptualization is characterized by considerable flexibility as to the aids the solver may employ in thinking about a problem. To solve a physics problem, for example, he might manipulate real objects, mathematical equations, mental "images", verbal arguments, or logical propositions. Such flexibility is possible because the solver is concerned not with the medium he happens to use, but with the factors to which it refers, and the principles governing these factors.

In contrast to the scientific emphasis on conceptualization, he argues, execution-in-a-specific-medium is the most central and least modifiable aspect of artistic problem solving. One may choose the medium to use in approaching a problem, but the solution realized is restricted to that medium. It can be neither captured in another, nor even reformulated in the same medium. Medium, however, should not be confused with notational system. Once a composer has selected his notes, or a poet his words, it is possible to record these choices in a variety of equivalent notations. The execution or work inheres not in the particular notation (conventional and translatable), but in the particular quality and relationships of sound comprising the poem or composition. These executions in sound cannot be translated into visual or kinaesthetic form as can, for example, a verbal description of an atom.

Gardner concludes that problem-setting can be a productive instructional device in both scientific and artistic education, but that the method, timing, setting and the nature of the problems posed require most careful consideration in the arts.

2.1.2 Search Strategies in Dense and Replete Symbol Systems

Just as there appears to be media-based trends differentiating artistic and scientific problem solving, further distinctions emerge when one considers the nature of the particular symbol systems used in the arts. The density and repleteness of symbol systems prominent in the arts (Section 2.2.2.3) influences in important ways the planning and problem solving behavior of the artist or critical viewer. Problem solving seems inevitably to involve conscious or unconscious exploration of alternatives. In dense and replete systems, there are an incredible number of degrees of freedom along which a work of art may vary continuously. Often the artist must adopt strategies calling for consideration of only some of these dimensions at a time. Sometimes in dealing with continuous ranges of possibilities, he may be able to search them in a continuous fashion, as a hunter tracks the flight of a bird. But often to survey a continuous space he must employ partial sampling strategies. What then are these strategies of limiting dimensions and of sampling or continuous search? Which are present in the novice's behavior and which develop naturally with experience, and which must be taught? At what stage and how should the child's awareness of differences among search problems and alternative strategies be broadened and sharpened?

2.1.3 Pathologies of Problem Solving

Other sections of this chapter have mostly focused on aspects of problem solving behavior involved specifically with the arts and dependent on the particular media used. But just as important is investigating the relevance of general principles of problem solving to the arts. The behavior of a subject, artist or non-artist, may exhibit "pathologies" of problem solving, habitual procedures that impede facile resolution of problem situations. The elimination of such bad habits and substitution of good ones may in itself be a significant contribution to the effectiveness of an artist. But what are these pathologies of problem solving? Two examples will explain.

A common procedure when facing a task is to conceive an approach and then try to explore or implement it. This will be called a "conception-elaboration" behavior pattern. For example, it occurs to a student to utilize a certain hue in water color, and he does so. If later he realizes another would have been better, it is then perhaps too late -- the error is not correctable. Similar quandaries may arise whenever one's first conception might prove unnecessarily troublesome or make a questionable or inextricable commitment. In such situations, preliminary consideration of several alternatives before extensive exploration of one might help but of course careful contemplation of alternatives before each individual act in producing a work of art is impossible. Nevertheless, the pathology of "momentum" in problem solving -- of trying an ineffective line of attack or trivial variations of it several times before confessing its inadequacy and reaching for another is a prominent feature of problem solving in non-aesthetic domains (see Maier, 1979). In arts education we need to be alert for the same pathology, while recognizing nevertheless that stubborn persistence may sometimes win through to good results.

These considerations have led to a plan of research, which the Project expects to carry out in the coming years. The aim is to explore pathologies of problem solving in the context of the arts, to classify types of pathologies, assess their frequency of occurrence, and consider means of eliminating them. Devising methods of analysis is the major task. It will be necessary to specify the precise conditions under which the above-mentioned behavior patterns will be said to have occurred. Further types of pathologies must be sought, and occurrence conditions established for them as well. The research of Maier and the studies by Polya (1957, 1962, 1965) of problem solving heuristics in mathematics can provide a guide for such research. There would need to be some evaluation of the detrimental effects of various pathologies, and the relations between the detrimental effects and the medium involved. For example, as described in Section 2.2, unrevisable media amplify the negative effects of the conception-elaboration behavior pattern. Such analysis requires at least a partial ordinal assessment of the cost of different sorts of errors in different circumstances, cost in such terms as time, frustration, and announced goals not achieved at all. Developing reliable and sensible means of such assessment is another difficult dimension of this inquiry.

Various general techniques of problem solving are powerful tools, and common errors of problem solving procedures are equally weighty impediments. It is a crucial task to determine whether such general considerations of problem solving ability have bearing on the arts, an area of endeavor generally thought alien to them. Such a finding would set the stage for particular research into educational procedures to eliminate pathologies. This research might also clarify the long standing issue of the relation between aesthetic and non-aesthetic abilities by determining what fundamental skills are common to both domains.

2.2 Revisable Media

The nature of the various media involved in artistic and scientific work has been another leitmotif of the Project's work, proving to be a suggestive way of organizing disparate findings. David Perkins has proposed that differences in the "revisability" of media may be expected to influence greatly the planning and problem solving processes involved in

artistic production. In ink drawing no mark can be readily eradicated. The stroke of the pen must be sure the first time, either through planning or through long experience and skill. But in producing a collage from given fragments of materials, an arrangement tried is not a commitment. Until the final glueing, the artist is free to explore alternatives by manipulating the medium itself.

Revisability is a matter of degree. Even in ink drawing an error may be corrected by adding to it so as to incorporate it into the work. Or, indeed, the work can perhaps be redone entirely, an expensive manner of revision but revision nevertheless. The degree of revisability varies inversely with the cost in time and effort of a revision.

What are the conjectured behavioral implications of this contrast? The person experienced in a medium will (1) exhibit particular techniques for avoiding or coping with revisability problems the medium presents, (e.g. by making a preliminary sketch) and (2) exhibit an ability to explore alternatives conceptually, without trying them out physically. The novice will perhaps find himself constantly boxed in by commitments made and later regretted. The more unrevisable the medium, the more it will frustrate and discourage his ability.

Thus there are dangers in exclusive use of non-revisable media: water colors, crayon, and even pencil and charcoal with bad erasers, etc. Modern technology should be able to supply effective erasers or opaquers for water color, crayon, etc., thereby making these media more revisable.

But any such advantage must be balanced against the important lesson these media may teach in their original form -- if this lesson is brought out. On the one hand collage and other revisable media permit the student the freedom and directness of immediate manipulation. But on the other, watercolor, ink, etc., introduce him to the constraints inherently involved in many common media. Watercolor and ink, as well as sculpture in stone or wood, fresco, engraving and so on have played so large a role in the history of art that there can be no question of their usefulness as media, and indeed the revisability problems they present may just as likely inspire as inhibit the mature artist. If indeed unrevisable media present the beginner with too many problems all at once - and that is a point to be investigated - at any rate ultimate mastery of techniques for dealing with such media is important.

2.3 Routines

Much of human behavior, including that involved in creative or artistic activity, is constructed from well-habituated routines which run off more or less automatically. Routines usually figure prominently in the discussion of motor performances such as speech or walking, but it seems equally useful to speak of such automized processes in other areas such as pattern recognition or problem solving. The same mechanisms may underlie the learning of motor skills and the kind of learning that goes into problem solving and pattern recognition facility.

Some commonalities are manifest at once. Doing sums, a problem situation for the child, becomes for the adult a mere automatic task, reliably and swiftly performed. Problem solving itself involves habits of procedure, and some habits may be more effective than others, as Polya's studies of problem solving heuristics suggest (1965). Reading, an undeniably perceptual skill, requires the fine coordination of eye movements, a motor skill. Bernstein (1967) stresses that in an unpracticed motor task, the most prominent regularity is simply that the performer does the task; his specific motions may vary drastically from trial to trial, but always "solve the problem" of accomplishing the end. As the actions become more and more habituated and routinized, they become more regular and steadily more efficient in the expenditure of energy. Here there is a further motor problem being solved -- the problem of accomplishing the task with minimum attention and effort.

The usefulness of the concept of routines is enhanced by the possibility of hierarchical organization. Complex behavior may be viewed as a hierarchy of routines, where "higher" routines depend upon the performance of the subroutines of which they are composed. This is no less true in the arts than in any other human endeavor. An impressive artistic achievement, even in the non-performing arts, certainly requires the habituated facility of the artist with his medium, although such facility by no means guarantees the achievement. The novice may, relative to his own present facilities, be just as "creative" as the expert, but his creativity is spent at a lower hierarchical level, dealing with matters which the expert resolves via well practiced procedures. Thus such questions as "How are routines established?" and "How can routines be organized into larger routines?" are of crucial importance to arts education.

However, just as important is the question: "How can routines be discarded when they are inappropriate?" Numerous psychological studies show that people are often "stimulus bound" by past experience, which leads them out of habit to perceive a situation or attempt to solve a problem in a conventional, unimaginative way (Taylor and Barron, 1963). Thus routines, which underlie and make possible complex creative behavior, paradoxically promote stereotyped behavior. The paradox is not real. The stereotyped behavior is the routine by itself; the creative behavior is composed freshly out of many routines. Thus it is important to investigate breaking away from routines as well as their construction. Can those who learn routines easily reject them with equal ease? Ease of learning and ease of unlearning may likely be closely correlated, in that learning a new routine might almost always involve the rejection of established behavior patterns.

From these many questions and few answers it will be apparent that "routinization" has not yet been the subject of extensive analysis and experimentation by the Project. However, the concept of routinization is a prominent implicit element in much of our research discussed under other categories. Worthy of particular mention are: the discussion of searching strategies appropriate to symbol systems, Section 5.2.1.2; the identification of "pathologies" of problem solving -- ineffective problem solving habits, Section 5.2.1.3; Bamberger's conception of the

development of perception in music, Section 4.1.1; behavior patterns exhibited in infants' first encounters with fingerpaints, Section 5.1.2

2.4 The Concept of Modes in Aesthetic Development

The Project's search for a comprehensive approach to artistic production and perception has not been limited to a consideration of the behavior of the practicing artist. Indeed most of our empirical investigations have used children or naive adults as subjects and we have hoped to define differences and commonalities between these and the skilled practitioner by observation of the more elementary skills and products of untutored individuals as well as analysis of the sophisticated performance of the mature artist. Since the Project's interest has centered on the nature of various kinds of symbols used in daily life and in artistic activity, the questions of how individuals initially come to use symbols is an important, though difficult one. Howard Gardner has made a preliminary analysis of the ontogenesis of symbol use, with specific reference to the possible characteristics of early aesthetic perception.

Commencing with a consideration of the concept of organ modes and vectors introduced by various developmental theorists (Erikson 1950; Werner and Kaplan, 1963) Gardner has proposed that sensitivity to these general properties of objects and situations may lie at the foundation of aesthetic perception (1970c). Gardner reviews evidence from studies of infant imitation which indicate that, rather than matching the region or zone of the body involved in the modelled behavior, children in the first and second years of life focus upon the general modal and vectorial properties of stimulus arrays. For example, Gardner and Gardner (1970b) found that, when they performed an action in front of their six week old infant, such as opening and closing hands or mouth, the infant was more likely to reproduce the mode (opening and closing) and the vector (a steady repetition about once per second) than the particular zone (mouth or hand). Similarly, Piaget (1951), Werner (1948), and other investigators have found that such modes as insertion, introjection, and intrusion, and such vectorial properties as speed, distance traversed, and spatial configuration are more salient for young children than the particular limbs or objects performing the actions. It is proposed that modes and vectors are meaningful units for analyzing a child's development but that investigators have avoided reliance upon them because of difficulties in measurement. Several possible methodologies for uncovering modes and vectors are discussed, and a possible developmental sequence is elaborated.

While much of development consists of learning to classify and view stimuli in more precise and limited ways (e.g., fullness, openness, intensity, penetration) an enduring tendency to respond to and to classify objects and situations in terms of general configurations seems to exist in most individuals. Agreement among observers as to expressive and physiognomic properties of abstract configurations in different media is cited as evidence for this proclivity among mature individuals in a given culture (Honkavaara, 1961; Pratt, 1961). Developmental evidence is also considered; for example, Gardner cites his experience with a five year old child who could effortlessly and consistently relate simple themes played on the piano to letters

of the alphabet. It is proposed that, whereas perception of objects for non-aesthetic purposes (e.g. botanical classification) often depends on a discounting of modal/vectorial properties, both the practicing artist and the artistic connoisseur continue to conceive of and to value objects in terms of the appropriateness and interest of their modal/vectorial properties. Symbol use by adults is more flexible, as symbols may belong to dense or to articulated systems, (Section 2.2.1). But the symbols that function in aesthetic forms are distinguished by their continued reliance on a penumbra of meaning which is characteristic of dense systems and which appears to draw on the same modal/vectorial sensitivity whose genesis is the subject of the paper.

Though this study may achieve success in delineating the early development of one aspect of aesthetic perception, it seems less relevant to the individual's encounter over time with a specific work of art. This problem has been considered at some length by Bamberger (Section 4.1.1), and Gardner and Bamberger hope in the near future to consider the relationship between general aesthetic sensitivity and the response to particular works of art.

CHAPTER 6. FURTHER THEORETICAL INVESTIGATIONS

Some intensive work by members of the Project has been devoted to the clarification of concepts - such as expression, representation, and imitation - prominent in discourse about the arts, and to the interpretation of these concepts in application to particular arts. These studies, which often call for some rather abstruse analysis and considerable technical detail, may seem remote from the practice of education and even from the fruitful investigation of education methods, but they are indispensable if the discussion and study of the arts and education are to be freed from prevalent and crippling confusions and misunderstandings. For example, the rhapsodical admiration of expression as the magic transmission of the artist's feelings to the spectator, or the 'common-sense' identification of representation with imitation can pretty effectively obscure the nature of artistic production and comprehension, and misdirect efforts to foster them. The reader unwilling to cope with the technicalities of the following sections should at least be on guard against some of his own ingrained and popular assumptions.

1. Expression in Music

Vernon Howard has been investigating philosophical and psychological justifications for speaking of music as "sad", "humorous", "merry", "lyrical", "majestic", etc. (1971). The philosophical status of such usages has been a matter of some controversy. Previous efforts to analyze expression by music can be conveniently grouped under three headings: Soft Formalism, which argues that statements like "The music expresses sadness" are reducible to metaphorical statements of the form "This music is sad", that describe structural features not readily formulated in literal terms; Hard Formalism, which holds that all such locations are low-level, ambiguous proxies for the literal language of music theory, and are dispensable, with training, in favor of the latter; and the Iconic Sign Theory, which construes metaphorical description generally and expression in particular as elliptical literal simile via the mechanism of the iconic sign -- in other words, the music is sad because it is "morphologically" like, or similar to, feelings of sadness.

Against these interpretations, we argue that Soft Formalism, though basically a fruitful approach, is incomplete in two respects: it does not explain why expressed properties should be treated theoretically as metaphorical; and it does not distinguish which among innumerable metaphorical properties of music are expressed properties: a piece might be described as an "old war horse" not for any of its musical features but because of its frequent performance. Hard Formalism errs in ignoring the fact that metaphor is ubiquitous in linguistic description, including music-theoretic contexts, and in hastily assuming that metaphorical descriptions can tell us nothing about musical structures that literal descriptions could not tell us better. The Iconic Sign Theory mistakenly presupposes that "morphological similarities", antecedently perceived, explain our use of metaphors in describing music, whereas just the opposite (that metaphors may generate perceived similarities) is equally plausible (Goodman, 1970).

A more satisfactory alternative is the Exemplification Theory which restricts expression to a subset of metaphorical exemplification (cf. section 2.2.2). A musical work expresses only those metaphorical properties possessed and referred to by the work construed as a symbol of a certain kind (Goodman, 1968, p. 87). Inasmuch as metaphor aids in delimiting structural features, the theory shows how we may be led anew to the music by metaphor and expression rather than away from it. Statements about what a work expresses do not concern associations with extraneous attributes or variable emotional responses. Rather, such assertions are in effect statements about features of the work's structure -- features that are often important and recondite. These features are no more 'subjective' than are obviously objective properties; and good internal objective agreement on them holds within a given culture or population. Hevner (1936, 1937, 1938) reports experiments where subjects associated descriptive adjectives of different moods with the music played. Subjects of varying education and expertise (but from the same culture) chose the same mood for the music quite consistently. Tempo and modality influenced most how a piece was described. Pitch was third most effective, with harmony and rhythm being less so. Cooke's musicological analysis of expression (1959) probes what specific musical "formulas" have been consistently used in Western music to express various moods. Thus, the constancy of correlation of literal and metaphorical properties in musical expression is supported by empirical studies. Naturally, there are variations and vacillations in listeners' judgments; but so indeed are there in judgments of, for example, distance, which does not preclude constancy of measurement. Like measurements, expressed properties are properly considered genuine properties of the work, though unlike measurement they belong to it metaphorically rather than literally.

2. Musical Denoting

In addition to claiming that musical works are expressive, Western composers have long considered their works to refer in various other ways including representation, naming, description, and quotation. Though each type of reference differs from the others, they all involve denotation by or of music. Vernon Howard has analyzed musical denoting in the context of programme music and opera.

(1) A system of leitmotifs in opera or oratorio is frequently designed to name and describe as well as to express. The purpose of a naming motif, just so far as it is denotational, is to stand consistently for and recall its compliant (e.g., Siegfried). The descriptive use of motifs is commonly a matter of affirming class membership or applying predicates as in natural language. If, for instance, a love motif be combined with a naming motif to indicate that so and so is in love, the result is a non-disjoint assignment to a class, or a musical description. As a symbol system, Wagnerian leitmotifs, for instance, constitute a descriptive system containing a notational sub-system consisting of all naming motifs.

(2) The relation between a naming motif and an actor performing a role is not ordinary fictive naming; for while it is reasonable to speak of Pickwick-names or Pickwick-descriptions as having null extension, this is not true of all musical names or descriptions for which there may be compliants before us on stage. What does the music denote in such cases? The Seigfried Motif, for instance, cannot denote a non-existent Siegfried. Nor does it denote simply the actor, since actors may vary from one performance to another. Two more plausible analyses of the situation are suggested. (i) The first is to take the naming motif as denoting the actor-in-his-role-as-Siegfried; that is, the actor understood as himself a Siegfried-symbol. This is still counter-intuitive in that one Siegfried-symbol (the motif) denotes not Siegfried but another Siegfried-symbol (the actor in character). (ii) Another possibility is to construe the Siegfried Motif and the actor in character as coeval Siegfried-symbols having null extension (and therefore coextensive) within the context of the work -- that is, as "parallel" Siegfried-symbols, neither one denoting the other. If (i) conforms to what audiences and players ordinarily (and loosely) say, (ii) corresponds to the familiar phenomenon of equivalence between written and spoken inscriptions in langauge and has the advantage of eliminating reference to transient actors in or out of character.

(3) What a piece of music expresses are certain metaphysical properties (or labels) that are both possessed by (or denote) and exemplified by the music. Description depends on what music under standard notation is taken to denote - as with the Leitmotifs. Part of the difference, then, between expression and description is the difference between being denoted and denoting. Given that difference, expression is a matter of the metaphorical exemplification of properties belonging to the music solely as music. Description, on the other hand, is a function of the music's denoting, ambiguously, non-disjointly, or inarticulately, while belonging to a notational scheme.

Much prima facie descriptive music actually falls into the category of expressive music, which is to say that the music exemplifies literally or metaphorically many of the same labels as denote whatever is mentioned in the title. Under standard notation, denotation is the key to musical description, but frequently we are at a loss to decide whether a piece is denotational. Hints or symptoms of denotation can be gleaned from such circumstances as the dramatic context of referential use as in opera, the relative prolixity and complexity of descriptive titles, the composer's stated intentions, or the habits of reference peculiar to a type of composition so far as they are known.

(4) Along with onomatopoeic devices, musical quotations and allusions are among those exceptional cases where reference is detectable primarily from auditory features of the music. One piece may allude denotationally to another by "quoting" it, like the "Marseillaise" in Tchaikowsky's Eighteen-Twelve Overture or "Dixie" in Ives' Second String Quartet. Or, as in Prokofiev's Classical Symphony, a piece may allude without quotation by literal exemplification of the general features of a musical genre. The criteria of quotationality in non-linguistic systems vary widely (cf. Goodman, in preparation), and there is the question whether musical quotation meets the strict standards of the linguistic analogue. A stringent suggestion of

necessary and sufficient conditions of quotationality drawn from language would involve replication (syntactic equivalence) plus denotational reference. At best, this defines a limiting case in music, where more usually replication of an original passage is approximate and reference is a function of assumed familiarity rather than conventional quotation-indicators. Comparatively, it can be said that musical and linguistic quotation alike involve replication plus reference, though the specific criteria of both replication and reference in music are at least less stringent, probably different (being largely psychological rather than syntactic), and certainly more vague. Although rigorous conventions of quotation could be introduced into music, a general indifference to the linguistic uses of music coupled with a maximum concern with auditory nuance legislate against any such imposition.

3. How Symbols Inform

Symbols in use normally provide information. Graham Roupas has explored the general theoretical question of how symbols inform.

To say that a given symbol x denotes a subject y is to convey certain information about y. If the symbol is the phrase "short, fat, and bald", an item of information conveyed is that y is short. If the symbol is a score of Beethoven's Fifth Symphony, an item of information conveyed is that y begins with three notes having the same pitch and duration. If the symbol is Gilbert Stuart's portrait of George Washington, an item of information conveyed is that y wears a wig. Some years ago, J. J. Gibson asked, "How do pictures convey information?" (1954). Roupas suggests seeking an answer to the more general question "How does predication of any symbol convey information?", before discussing what is distinctive about pictorial communication. There is yet another dimension along which an inquiry should be generalized. If someone says "Here is a score of last night's performance, and here is a score of tonight's", presenting first a score of Beethoven's Fifth Symphony and then a score of Mozart's G-Minor Symphony, an item of information conveyed is that last night's performance began on a higher pitch than tonight's does. When a series of symbols is predicated respectively of a series of subjects, information is conveyed concerning certain relations of those subjects to one another.

It has been well pointed out by Max Black ("How Do Pictures Represent?") that the notion of information illustrated in the preceding paragraph has little to do with the concept employed in the "information theory" of Shannon and Weaver. In the first place that concept concerns only the probability with which a signal is emitted or received, and thus applies even to signals that convey no information in our sense, i.e., that carry no meaning. Secondly, Shannon and Weaver are concerned only with measuring amount of information; whereas we wish to explain the sense of saying what information a painting or other symbol conveys. The nature of our enterprise thus renders wholly useless any conception of information as a kind of homogeneous fluid "contained" by symbols in various amounts.

The information conveyed by predicating a symbol of a subject is that the subject has the properties ascribed by the symbol. Part of the answer to the question of how a symbol ascribes properties is that the symbol has properties itself, which we ascertain or otherwise register (perhaps subconsciously) in order to know what properties the symbol ascribes. In addition, of course, the symbol must be interpreted in some way - that is, what the symbol refers to must be discovered. There may be various alternative systems for interpreting a symbol, and the properties ascribed by that symbol will vary according as one or another system of interpretation is chosen. The inscription "son" conveys one thing when predicated by a Frenchman and quite another when predicated by an Englishman.

What a given symbol ascribes in virtue of possessing a given property depends not only on what the symbol denotes, but also on what is denoted by other symbols having the property in question. A given property or relation of symbols may be said to be an informant, relative to a denotation-relation, of a given consequent property or relation of objects. Denotation between individuals gives rise to the relation of informant to consequent between properties. This may be a step toward dealing with some questions concerning the informational capacities of systems, the ways systems may be informationally equivalent, and others the ways properties of symbols are informationally relevant or irrelevant.

4. Picturing and Imitative Symbols

In the light of his study of how any symbol conveys information, Roupas returns to a consideration of pictorial information. Gibson's latest view (1971) is that the information contained in the optic array delivered by a picture is the same as the information contained in the optic array delivered by what the picture denotes; although he no longer holds, as he did in 1954, that the two optic arrays themselves must be the same. But how are we to understand the words "information contained in an optic array?" After all, a written description delivers an optic array too, and such a description might ascribe just the same properties that we should be able to ascertain upon being presented with an optic array from the subject of the description; yet a written description is no picture.

Gibson's view seems to be linked with another view about the nature of picturing, according to which it is characteristic of pictures to convey information by imitation. Pictures are not, of course duplicates, replicas, or copies of what they denote. Rather, the idea is that sometimes when a picture ascribes a property P it does so in virtue of possessing P itself; P-P is an informant-consequent pair relative to the picturing-relation in question. Though in many respects pictures are imitative, contrast a symbol that is not a picture, such as "short" interpreted as a word of English. This is true of itself and thus has all the properties

it ascribes, but it does not ascribe all these properties in virtue of possessing them itself; for not every short word ascribes Being short, as the word "long" illustrates. On the other hand, general classification of the appropriate notion of 'property and 'by virtue of' involved here presents formidable difficulties. The demand that all information be conveyed by imitation would mean that a symbol can imitate nothing but itself. What seems wanted is the notion of a system such that all "relevant" information is conveyed by imitation. One interpretation of "relevant" might be that a "relevant" consequent property is one which is the logically strongest consequent of some informant; accordingly a picture of George Washington would, in telling us that Washington wore a wig, logically also tell us that "Washington wore a wig OR some mice are white", but only the former would be a logically strongest consequent. But now, since "wore a wig" is a predicate appropriate for people but not for picture surfaces, it cannot be imitative here.

The concept of an imitative system is of interest in its own right but its relationship to the popular and vacillating notion of imitation is complex. Further study by Roupas of this relationship involves more technicalities than can appropriately be set forth here; but illustrates the facts that (i) even so commonplace a notion as imitation harbors enormous confusion, and that (ii) patient technical analysis can not only clarify these notions but sometimes throw unexpected light on related matters.

CHAPTER 7. EDUCATION IN THE ARTS

All of Project Zero's efforts have been directed, ultimately, toward improvement of education in the arts. But the Project has consistently eschewed a reductive interpretation of education as "training" or "schooling". No one acquires an education exclusively, or even chiefly, in an instructional setting. Thus, the research summarized in preceding sections of this report often is based on a broader construal of the occasions of learning; for example we have considered the skills involved in the "reading" of pictures, style recognition in various art forms, and problem solving, although such skills are normally acquired without explicit instruction or training in them (whether such instruction might be useful, though, is an important question).

Nonetheless, in keeping with its embedding in a Graduate School of Education and its primary mission, the Project has sought a detailed acquaintance with problems of instruction in the arts. Again, we would take instruction broadly, including under the term such non-classroom arrangements as coaching and apprenticeship. Our concern with instruction in and out of the classroom has been sustained by the presence on the Project staff of specialists in curriculum and child development, while visits by experts in instructional analysis and evaluation have provided fresh views for consideration. Interest and opportunity thereby converged to prompt a series of investigations addressed to aspects of education in the narrower sense, education as pedagogy.

Those studies constitute the substance of the following chapter. They include observation and analysis of both conventional and unusual instructional practices; the rudiments of a taxonomic scheme designed to bring greater precision and refinement to the observation and description of teaching methods; and an approach to evaluating methods of instruction in the arts that sidesteps evaluation of the art product. Also described are the Project's own modest efforts toward arts education -- our series of lecture-performances, our urging of and participation in a program in arts management in association with the Harvard Business School, and our own "Project Zero course", introducing students at Harvard to research in arts education through involving them in small research projects designed by them in cooperation with Project members.

1. Themes in Contemporary Arts Education.

Project Zero employs various means to ensure an up-to-date knowledge of the various current trends and practices in arts education -- readings in the literature, guest speakers, discussions and correspondence with others in the field, and finally, direct observation. The last is our concern here. In past years, members of the Project have visited a number of institutions with active programs in the arts. These expeditions have yielded a factual knowledge of various procedures followed, as well as revealing various problems and issues that plague arts education.

1.1 College and Professional Training of Artists: Site Visits

The numerous institutions which offer college level or professional training to potential artists vary widely in their educational practices. The Project has visited several of these institutions in order to survey their procedures and philosophies. The general approach has been to spend a day or two at the institution, interviewing students and faculty, observing classes and attempting to imbibe its atmosphere. Interviews have probed the general philosophical orientation of the institutions, sought opinions on questions of interest to the Project, and invited suggestions for future inquiries. The individual findings are necessarily confidential, but various major issues have emerged.

Theoretical Underpinnings:

A number of schools seek, deliberately or inadvertently, to disseminate a particular view of the arts. The Bauhaus-Gestalt tradition is particularly favored in several schools and dictates an emphasis on problems of design and on the achievement of such qualities as balance, harmony, rhythm, which are difficult to define but which those "in the tradition" can recognize. The presence of a dominant theoretical orientation may serve as a limiting factor, giving students an unnecessarily restrictive notion of the arts or even acting as an anti-creative factor (design as the science of art can be a dangerous slogan and practice) and underemphasizing the development of motor skills, for example. On the other hand, such a perspective can provide a convenient language, a set of standards that can be learned, a sense of belonging to a craft, an increased feeling of competence, and even a tradition against which one can profitably rebel at a later date. A number of institutions are dissatisfied with the Bauhaus approach, deeming it dated and misleading, but have so far not installed any successor.

Degree of Professionalization:

Concentration upon a particular art form and the training of the artist is characteristic of the professional school; interest in problems of design and training of connoisseurs is characteristic of the liberal arts college. Faculty at professional schools which have a full commitment to the arts, and at the liberal arts schools which have no such commitment, seem more satisfied about what they are doing than instructors at those schools which attempt both to provide training in the arts and a general liberal arts education. That these two goals may be antagonistic to one another has sometimes been argued. But such forced separation is antithetical to the general thinking of the Project, and has such grave disadvantages as an isolation of artist from audience. How to integrate the two goals is a vital problem of education.

Attitude Toward Problem Solving Approach:

Instructors at some institutions regularly introduce particular problems to their students, evaluate the solutions in terms of shared criteria, and show concern about the acquisition of specific skills; other instructors feel that creating is a mysterious process of inspiration which can easily be impeded by instructions and problems. They are interested in the production of a satisfactory end-product rather than in the skills necessary for attaining this goal. Sometimes this latter philosophy is more characteristic of upper-level courses, where the student is assumed to have the requisite skills and knowledge of the medium and is already considered a practicing artist. At other institutions, however, the words "skills" and "problems" are anathema at every level. Dislike of such terminology does not mean, however, that no skills are taught or that no tasks are set, but rather that they are introduced in a less direct or self-conscious way or that they differ markedly from standard ones.

Display versus Concealment of Instructor's Work:

Some instructors believe that a student will feel constrained to produce the kind of works his instructor creates, either because he wants a good grade or because he has become convinced that his instructor's is the only way to paint or compose. Other instructors feel that apprenticeship in an atelier is an optimal method of education and the student should as a matter of course see examples of the instructor's own work. Perhaps neither extreme position need be espoused. Perhaps what should be avoided is exclusive or overemphatic exposure of the instructor's work. An instructor or a group of instructors might provide a variety of models, so that the student does not embrace the simple-minded notion that only one technique is appropriate. The student might also be given a variety of models, or might be asked to criticize his instructor's own work. Similarly, imitation need not be a direct copy of a model but rather a noting of certain features of his performance or product and an emphasis of these aspects - in this wider sense, much of learning involves imitation. Finally, in watching a teacher at work, the student receives insight into the way certain effects are achieved, but also comes to appreciate aspects of the artist's relationship to his own work - his love for it, impatience with it, criticism of it - thus adding an important dimension to his training.

It is worth noting that some schools prefer to have professional artists as teachers while others are more interested in instructors noted for their teaching ability.

Role of the Arts at an Institution:

Clearly of some importance are attitudes of faculty and students toward the arts and the sciences, as well as the relation between the arts and the rest of the educational community. Nearly any generalization in these areas would be risky, but most signs suggest that an

easy and comfortable relationship between the arts and other aspects of school life is difficult to realize. New kinds of arrangements at liberal arts schools are urgently needed (cf. Ackerman et. al.).

The visits to the schools have exposed various problems and raised specific issues. Although decisive resolution of these must wait upon further analysis and experimentation, there is little reason to expect that one must take an extreme position on any of the issues. Perhaps, indeed, the balance will vary among the art forms (imitation may be more appropriate for a pianist than for a playwright) or across individuals (some students need more controlled skills, others could use more whimsy or madness). Equally likely, these different instructional emphases have their place at stated times in the aesthetic education of the student.

1.2 Pre-college Training: The Arts in Alternative Schools

The Project has also conducted an on-site investigation of arts instruction below the college level, in "alternative schools", a category which includes a wide range of experimental institutions. A consequence of this work was the paper "The Arts in Alternative Schools" by Project member Dr. Barbara Leondar (1971). The major conclusions were as follows.

In alternative schools, the arts tend to be highly regarded. This is consistent with other values widely accepted among alternative schools, especially those of freedom (interpreted as absence of restraint), individuality, and diversity. Paradoxically, however, certain practices consonant with these values tend to inhibit aesthetic growth in both the individual and the group. For instance, the emphasis on freedom, coupled with a concern for social interaction, virtually abolishes privacy and quiet, while the restless tempo of many schools similarly precludes concentration and the discipline of drill.

The very conditions which discourage the fine arts, however, tend to encourage the handicrafts. Thus, what counts as art to the free-schooler is more likely to be metal or leather work, pottery or textiles, than drawing, dance, or drama. Nonetheless, despite a generally bleak outlook, some real alternatives in aesthetic learning can be found. They are likely to fit one or more of the following categories.

The open studio:

This is a workroom equipped with the tools and materials of one or more of the arts and open to any student at any time. Generally it is one element of a more comprehensive system that includes open

laboratories, shops, and resource centers. Better suited to the visual arts than to others, the open studio has as its chief value the opportunity to explore freely without academic or psychological damage.

The artist as school teacher:

Schools have sought in different ways to attract working artists to their faculties. Some imitate university practice by installing an artist-in-residence who, in return for work space and perhaps board and housing, makes himself available to students. Others bring visiting artists in for a single day. The former provides continuity at the cost of diminishing impact; the latter assures immediacy which, however, cannot be sustained.

The most successful pattern combines immediacy and continuity. The professional artist who returns to the same classroom periodically, in the same manner as the school system's own specialist teachers, may represent the most fruitful manner of working with children (cf. Koch, 1970). To confirm this, thoughtful long-range observation, analysis, and evaluation are needed.

The student as apprentice:

Some alternative schoolmen argue that schools render a disservice by isolating children from the real business of the world. Thus, instead of bringing artists into schools, they prefer to send children out to the places where artists work. Philadelphia's Parkway Program is, of course, the archetype. When schools fail to provide such informal apprenticeships, after-school centers may develop to fill the gap, centers where practicing artists open their working quarters to interested children for some part of the day. Although promising, most such developments are too new to permit evaluation.

The student as teacher:

Among alternative schools, interest in peer teaching has been encouraged by certain egalitarian premises, chief among which is the denial of distinctions based on rank, and thus of distinctions between teacher and student. Students are empowered to instruct but, since they lack academic preparation, they will most commonly teach performance skills, including the arts and crafts. While the quality of such instruction is mixed, it embodies some desirable elements, including provision of a model — perhaps the only model in the school -- of discipline, purpose, and achievement. The greater benefit, however, may accrue to the tutor who must, under the questioning of students, make explicit much of his subliminal knowledge.

To summarize, despite certain notable exceptions, alternative schools have traded the old formalism for a newer disorder. They are not the panacea claimed by their enthusiasts yet they are at least open to new ideas and continue to search for an effective blend of educational

techniques. In addition they have engendered one exceptionally promising practice, the engagement of working professionals in the education of children.

2. Toward a Taxonomy of Methods of Education

Our on-site and other investigations have provided considerable raw material on educational practice. The need to organize this material has prompted the Project to undertake the development of a taxonomy of educational methods. The taxonomy is designed to call attention to the variety of possible instructional techniques and to suggest that methods which have proved effective in apparently remote realms (e.g. training athletes or aviators) may have relevance for aesthetic education.

The present list of teaching methods needs additional work before claims to exhaustiveness or mutual exclusiveness can be made, but it has already proved a useful way to analyze certain educational techniques. The following factors have been specified: (1) task setting -- e.g. "draw a man" (2) prescribing procedure -- e.g. "start with an oval for the head-etc." (3) illustrating procedures -- teacher draws oval (4) informing -- historical background of the arts (5) equipping -- supplying pencils, paper (6) participating -- helping child hold pencil (7) evaluation -- grading, providing feedback (8) inciting -- encouraging, rewarding, providing inspiring obstacles (9) providing an enriched environment -- displaying pictures about the room. A factor may be described in greater detail (prescribing can be linguistic or pictorial, direct or indirect) and may involve other factors (prescribing may be considered a mode of informing). Nonetheless teaching processes can be differentiated according to their emphasis on one or another factor. Thus, drill consists largely of repeatedly setting tasks, with occasional evaluation. The lecturer principally informs and may also illustrate. The master of the Socratic method illustrates by his own conduct, participates in the inquiry, and incites by his criticism.

A certain profile of these factors may be characteristic of education in the arts. For example, in the teaching of piano, informing occupies a marginal role and inciting might be very important, particularly in the first stagea, where the student can easily get discouraged; in dance, illustrating and evaluating play prominent roles. More generally, the methods of prescribing and illustrating procedures may have to be used with considerable care in the arts, while they are used abundantly and naturally in the sciences. Some art instructors are wary of demonstrating their own artistic techniques, lest students merely imitate them or become discouraged by a superior expertise; in contrast the teacher of chemistry need not be concerned if his students learn to imitate his experimental technique.

This taxonomy of educational methods demands a complementary taxonomy of means of learning -- the situation from the student's point of view rather than from the educator's. A list of that sort might include categories such as memorizing, practicing, solving problems, consulting information sources, and imagining. Such a double scheme and extensions of it should provide a tool for the analysis of existing programs in the arts and specify some of the building blocks available for the construction of new programs.

3. Trial Programs from Project Zero

The Project has not been content to operate in a vacuum divorced from the labors and lessons of practical education. We have apportioned a moderate amount of time to organizing a series of lecture-performances for the Harvard Graduate School of Education and the general public, to helping prepare for and conduct a summer institute in arts management at Harvard, and to conducting a Project Zero course at Harvard. While these activities cannot in themselves be called basic research, they are important to our fundamental emphasis on basic research, being a continuing source of the insight that only practical experience can give.

3.1 Lecture-Performances: Art in the Making

The lecture-performance or performance-demonstration is a means of audience education. For the past three years Project Zero has produced a series of lecture-performances for the Harvard Graduate School of Education, the Harvard community, and the general public. Frank Dent for the last two years, and Barrie Bortnick for the first, organized and managed the details of the programs. Professional artists of the highest calibre conducted the presentations in consultation with the Project research staff. The programs were designed to provide insight into the means by which an artist shapes a work of art.

Characteristic of the aims and methods of the series were the six presentations planned for the 1969-70 academic year, under the general title "Art in the Making". In the first, on still photography, Dr. Alfred Guzzetti of the Harvard faculty displayed side-by-side alternate treatments of the same subject, and recreated for the audience the comparisons and judgments which led him to choose one rather than another for inclusion in a forthcoming book. The second program, entitled "The Director Who Chooses", offered four different versions of a scene from Arthur Miller's Death of a Salesman, two live and two on film. George Hamlin, associate director of the Loeb Drama Center at Harvard, compared the four, revealing places where the different directors' differing conceptions of the play emerged. The last fall presentation featured noted poet and critic I. A. Richards reading from his own works, some of them unfinished, and commenting on problems and opportunities for expression in each.

Modern dance, mime, and music were the themes of the spring presentations. Ann Tolbert, director of the Dance Circle Company, choreographed a work in celebration of the centennial of Sanders Theater, a vast nineteenth-century gothic memorial to Harvard's Civil War dead. The particular aim was to illustrate how the setting could be strongly integrated into the work: banisters, moldings, statues and even the basement of the building itself were utilized in the dance-movements and in other aspects of the presentation. In the second spring offering Jacques Lecoq, director of the School of Mime and Theater Movement in Paris, made his first U. S. appearance in a "conference-spectacle" on the subject "Mime,Mask,and Contra-Mask." Following analysis of the language of gestures as observed in daily life and translated into the

techniques of mime, M. Lecoq explained and demonstrated various masks developed by the Commedia dell' Arte, and by himself. In the final lecture-performance under the title "From Sight to Sound" Leon Kirchner, Pulitzer-prize winning composer and director of the Boston Philharmonia, discussed some of the factors that affect the interpretation of music. Points were demonstrated by Kirchner at the piano, and by a small chamber group.

The events, all free to the public, are scheduled toward the middle of each semester and publicized throughout the university and the city, though the primary audience is the staff and students at the Harvard Graduate School of Education, who plan to enter secondary school teaching and administrative careers. Attendance has ranged from 250 to more than 1100 with approximately half of each audience from the School of Education. The setting for the presentations is generally a university lecture room with a low platform and stations for audio-visual equipment. Most programs are approximately two hours long, with a brief intermission and refreshments served afterwards. All include opportunity for the audience to question the artist during or after the event.

As the series' title "Art in the Making" suggests, the Project's concern is to reveal something of the artist's way of working, not just to display and explicate his products. Each event unveils patterns of dealing with artistic problems rarely seen in public: the exploration of alternatives, the meeting of constraints imposed by different media, the constant reworking in search of the right effect. The programs stress that the artist continually perceives, compares, and selects among options, and that a completed work is generally achieved choice by choice, rather than in one burst of inspiration.

But our aim is not simply to put the artist on display. We would invite members of the audience to some extent to identify with the artist, empathize with his position, and confront his problems. We would engage them, so that they become alert to less obvious distinctions and begin to decide on their own where the piece might be touched to alter its meaning and impact. An audience of many types — pupils, disciples, competitors, critics, buyers, and passive "appreciators", is encouraged to abandon its customary viewpoints and join the artist in articulating what he generally does in silence and alone.

At its best, this effect is subtle and rare, a goal always sought, occasionally approached, but seldom fully achieved. The Project marshals a variety of means to encourage rapport. The artists invited are carefully chosen not only for the merit of their work but for their openness and their sense of pace and showmanship. Questions and comments are invited both during and after the presentation. The artist is informed of, and encouraged to tailor his program to, the sophistication of the expected audience. In addition the artist is invited to a meeting with members of the Project 's basic research staff where an outline of the presentation is discussed. Often the artist's plan has been altered somewhat in response to inquiries and comments by Project members and a more revealing lecture-performance has resulted.

The emphasis in these programs on the details of the artist's functioning - his explorations, discriminations, problem solving and the like, derives directly from various conceptions at the center of the basic research effort which is the heart of Project Zero. The lecture-performance has provided a laboratory on arts education where we could informally experiment with the communication of these ideas, as well as with the communication of points about particular art forms and techniques. Although we emphasize analysis of basic issues and experiments which probe fundamental skills, this modest involvement in an actual effort towards arts education has been and should continue to be of great benefit to the Project as well as serving the public.

3.2 Education for Arts Management

That the skills of the producer are essential to production in many of the arts is a truth as neglected as it is obvious. In theater and opera -- and in music and dance when many performers are involved -- organization, personnel management, promotion, sales, accounting, financing, and other business functions are means not merely of marketing finished work but of making it possible. These arts require coordination of many people, money, housing, and an audience. And even if the poet and painter can work alone, the effect of the publisher and dealer on production are by no means negligible. Museum management, also, can do more than acquire, preserve, and display works of art; it can use them to develop understanding and (unless distracted by pressure to give the artist direct support) to educate an audience for the artist.

Project Zero has recognized from the beginning the vital importance of management in the arts, but was unable for some time to do anything towards improvement of education in this field. Then Mr. Thomas Crooks, Director of the Harvard University Summer School, asked us for ideas for summer programs in arts education. We suggested introducing a course in arts management. As a result, a committee was formed, and a valuable supply of relevant case material was made available by professors in the Harvard Business School Faculty.

We finally settled on a four-week, full time, intensive Institute, beginning in the summer of 1970, with a faculty consisting mainly of members of the Business School. The Institute has now completed its second summer, attended by junior and senior people actively engaged in various aspects of management of orchestras, opera and dance companies, museums, arts centers, arts councils, etc. as well as by students and prospective managers. In both years twice as many applications were received as could be accepted.

In addition to making the initial suggestion, the Director of Project Zero was a member of the planning committee and was on the faculty for the first year. He and Howard Gardner also prepared a case study on the question of museum admission fees; and this study was used to introduce discussion of fundamental issues concerning the goals and functions of museums. Through a compilation of excerpts from various

museum reports from many different years, attention was again focussed on implicit and explicit aims, and on the relative weight given to acquisition, conservation, scholarship, exhibition, entertainment and education.

Still badly needed is more study of those aspects of arts management that are peculiar to production in the arts: ways of selecting directors, performers, companies; special problems of working with artists; maintenance of artistic standards under severe practical difficulties; means of developing sensitivity and interest in the prospective audience; selection among or integration of several objectives: superior productions, development of the art and of artists, education of the public, and survival. Although the baffling problem of how to foster such skills urgently needs study, it is almost completely ignored.

3.3 Research in the Arts and Education: A Project Zero Course

The third of our instructional efforts centered on those students from among whom will emerge educators and researchers for the years to come. A major endeavor of the current academic year for Project volunteers Bamberger, Kennedy, and Leondar was the design and implementation of a Project Zero seminar, offered to the Harvard community in the spring semester under the joint auspices of the Graduate School of Education and the Department of Social Relations. A new departure for Project Zero, the seminar was born as the resolution to a cluster of problems. One of these was the Project's interest in wider dissemination of its findings, a concern which also generated our Technical Report series. Another was the School of Education's wish to extend its instructional offerings in the arts as well as to inspire increased interest in aesthetic research among students. But perhaps the most salient motive was the Project's desire to expand available knowledge in its fields of interest, and to do so by training prospective researchers to enter those fields. Our consequent experiences are offered here as a model -- albeit certainly a preliminary one -- of one means of accomplishing such training.

The Project's emphasis on original investigation thus became the focus of the seminar as well. The seminar rejected a plan of study which would have concentrated on analysis of existing research; instead, the planners agreed to provide close supervision of small-scale investigations designed and executed by individual students. The course was therefore advertised as requiring a considerable familiarity with one or more of the arts and at least an elementary acquaintance with the aims and methods of analytic philosophy or cognitive psychology.

Because the Project has found the interdisciplinary mix of its staff a source of stimulation, that feature, too, was incorporated into the course design. Although planned by specialists in music, literature, and visual perception, the seminar drew upon the entire range of expertise represented in the Project. Thus students had access to consultants in cognition, child development, language studies, aesthetics, lecture-performance techniques, and curriculum design. Ultimately, six Project

associates served as supervisors of students' research, and every paper received two or more readings.

Before individual investigations could be launched, however, some introduction to the Project's personnel and purposes was required. In four weekly lecture-discussion periods (with appropriate background reading assigned) the principal faculty members reviewed the Project's central concerns and the conceptual framework within which it operates. Emphasis throughout was upon the symbolic, cognitive, planning, and problem-solving aspects of the arts. Interest in these meetings ran high; perhaps a score of auditors, prevented from enrolling by restrictions of time or inadequacies of preparation, nonetheless attended the lectures. Those enrolled were concurrently engaged in drafting research proposals for submission to the faculty, who not only provided advice and direction but also drew up individual reading lists and arranged access to experimental settings and subjects. Although staff members tried not to impose their preconceptions, they insisted on clarity and precision in students' formulations, and simplicity in experimental designs. Several proposals which relied, for example, upon an unexplicated notion of "creativity" were discouraged, as were others which sought to construct a curriculum upon an insufficiently elaborated base of research.

By the close of the four-week introductory period, each student had consulted at least twice with a faculty advisor (some had conferred many times with a number of advisors), had read intensively, and had submitted an acceptable research plan, first in tentative and then in final form. At the following two meetings each student presented his proposal to the seminar, and thereafter the group dispersed to execute its plans. Although supervisors continued to meet with individuals or with groups of two and three, the seminar as a whole did not reconvene until near the close of the semester. By then experimental data had been assembled and tentative conclusions formulated; at two final meetings these were presented, analyzed, and assessed.

In all, fifteen students completed thirteen projects (two were joint endeavors). The enrollment included Harvard and Radcliffe undergraduates as well as students from the graduate faculties of Arts and Sciences, Education, and Design. Among their products were a slide-tape of an artist at work, showing successive stages in the construction of a design (this tape was shown at the Fogg Museum, Harvard University, in conjunction with an exhibit of the artist's work); an analysis of the notion of style, contrasting an "organic" with a "linguistic" approach to the subject; a systematic and closely observed account of the effect of a series of theater exercises on the progress of nine drama students; and a critical assessment of the pedagogical methods of two contemporary composers, Orff and Kodaly, in light of Piagetian psychology. The remaining studies fell into two groups, one addressed to aspects of children's literary development and the other to visual perception as related to problem-solving or information processing.

The most successful project, and the only one recommended for

publication, was produced by two students of architecture, Theresa Garcia-Cruz and Andrea Nagode. Using as data their classmates' solutions to a studio problem, they developed and applied a system of analysis by which certain features of a designer's problem-solving procedures can be inferred from his drawings. The significance of this investigation resides less in its specific findings than in the invention of a generalizable mode of analysis. Such a method can allow the design instructor to locate insufficiencies in his students' planning processes, rather than in their final products, and can be more broadly applied as well in demonstrating the effects of particular procedures upon completed designs. A refined and extended version of this project has been planned for presentation to a Design School audience next fall.

While students and instructors expressed general satisfaction with the seminar -- certainly both groups learned much -- the staff would hope to revise future versions in the direction of greater coherence. The wide diversity of problems attempted, the discontinuity between introductory lectures and particular projects, the omission of common instruction (as distinct from individual coaching) in the design of research -- all these require some adjustment, though certainly not so much as to transform the seminar into a conventional classroom course with individual papers required. Not enough ingenuity was applied to exploiting the potential for cross-disciplinary cooperation; investigations of visual or musical problems, for example, were not correlated with literary studies. Ideally the seminar should encompass a full year, including a semester of demonstration, reading, and analysis, and another of guided research. Nonetheless, the gains accruing from this first attempt seem more than sufficient to inspire a second. As an instrument for disseminating Project findings and for generating new ones, the seminar repaid expectations.

4. The Problem of Evaluation

4.1 Theory

How is a method or program of education in the arts to be judged? This perplexing problem haunts our study at every step, for if we know what we are doing, we ought to know how to tell whether we are making progress towards our goal.

Some of the troubles here are common to other research in education: the long time between a course of education and its eventual results, the difficulty of distinguishing the effects of the education from those of countless other intermingled factors, the near impossibility of maintaining nearly adequate experimental controls. With arts education, though, the problem of evaluation is gravely aggravated by two further factors.

The first consists of prevalent confusion about, vacillation among, and intermixing of goals. Although the natural first question in attempting

to evaluate a given program is "What is the objective?", few of those who ask for evaluations are prepared to answer unequivocally, and some even resent the question. Examination often reveals a tangle of incongruous aims: providing means of recreation or escape, development of personality, spiritual or moral uplift, social elevation, improvement of practical skills, etc. But while this confusion troubles the evaluator in the field, we cut through it so far as our research goes by setting as our goal the improvement of production and comprehension of works of art. If pursuit of this goal conflicts with realization of others, the choice among or balancing of goals is not our concern. Our problem of evaluation is solely that of judging effectiveness with respect to this one goal.

The statement of our goal only underlines, however, the second and chilling difficulty: if improved productions means production of better or of more good works of art, by what standards are works to be judged? When the problem is not ignored by educators, it is usually answered in one of a number of unsatisfactory ways. Sometimes, one particular set of canons is explicitly or tacitly accepted, with no recognition of the variability and dynamism of standards of aesthetic merit. Sometimes, the matter is vaguely referred to "experts," ignoring ubiquitous disagreement among experts and the fact that with respect to current and developing art, judging an expert is as hard as judging a work. Unless we are reconciled to programs of art education designed to perpetuate the status quo at a particular place and time, unless we are ready to accept as ultimate a program of education that produces a generation of Rosa Bonheurs or several generations of summer resort painters, we have to find a better answer.

In reaction against provincialism and absolutism, sheer innovation has sometimes been taken as the criterion of merit; but obviously mere departure from local and transient standards has little more to recommend it than does conformity to them.

The temptation is to resign the problem, and leave the appraisal of a program and of works to the sensitivity, taste, and judgment of the individual director. These qualities are indeed invaluable; but to leave the matter there is to abandon all search for any general communicable principles that can guide and supplement -- and aid us in judging -- such appraisals.

Since obviously we cannot attempt to establish reliable and permanent canons of aesthetic value, we are faced with the nasty question of how to validate research or test conclusions without such canons. An important part of the answer is that we must judge educational ideas and programs less in the light of aesthetic standards applied to the ultimate results than in the light of what we can discover concerning the functioning of human beings, the nature of the processes involved in various phases of the production and understanding of works in the several arts, and ways of fostering abilities to carry out those processes. If we can judge comparative effectiveness of equipment designed to operate on Mars, with no opportunity to observe actual performance, perhaps we can estimate the way various educational programs may provide means necessary for or

or conducive to production or understanding in the arts. (And to forestall an eager objection, we are not saying that an artist is mechanical equipment.) Thus the criteria for evaluating educational programs will evolve as research proceeds and knowledge of relevant factors increases. But this answer calls for a good deal of explanation and defense.

The central notion here is that we bypass the question of aesthetic standards by focusing upon those abilities that are necessary or conducive to production or comprehension in the arts. Certain skills are required for riding a bicycle -- whether riding well or badly; a dancer, good or bad, has to be able to execute certain movements; and so on. Mastery of the component skills, of course, does not imply being a good bicycle rider or a good dancer; and just for that reason, to forego judgment of overall performance or ultimate result is not to forego judgment of improvement in component skills. An important consideration here is that much of the disagreement about aesthetic standards leaves untouched considerable agreement about abilities to perform processes essential to artistic production. To oversimplify (almost to caricature) the point, those who disagree about whether a student can paint well or draw well may agree entirely as to whether he can draw a circle well. This to some extent explains the emphasis in our research on the nature of problem solving in the arts. Skill in working sample problems in art or science is not sufficient for superior performance but is an indication of progress.

The reader will naturally object that the virtues of this approach arise from and throw into relief its fatal defect. For if judgment of success in performing sample exercises and mastering component skills does not imply judgment of overall performance, that is just because these component abilities by no means ensure superior overall performance; and there is thus no guarantee that an educational program that improves these component skills will result in better production or understanding. Here a comparison with education for science is helpful. What scientific education does, for the most part, is to provide the means needed and helpful for scientific work. The ability to do arithmetic, to perform simple experiments, to carry out logical arguments, will not make a great or original physicist, but one can hardly become a superior physicist without these accomplishments. Had science education focused exclusively on developing the creative scientist, or finding and nurturing the genius, it would be in as sorry a state as is art education today. Throughout our work we have subordinated the usual concentration upon "creativity" to consideration of ways of providing means. Possession of requisite or conducive skills makes possible superior performance by those capable of it.

Some of our examples may have given the false impression that we are concerned only with such simple skills as drawing geometric figures, playing scales, or (in science) doing arithmetic. But just as training in science involves developing also such more complex skills as performing quantitative chemical analyses, developing promising hypotheses, and designing crucial experiments, so must education for the arts involve developing such skills as making fine perceptual discriminations, grasping elusive

relationships, discerning obscure patterns. For example, an artist cannot work with differences he cannot detect. Which skills are more important -- indeed, which skills are needed at all -- may vary with the art and the phase of artistic production or comprehension in question, with style or school or doctrine, and with the individual artist; for instance, subtlety of sensory discrimination rates low for many contemporary artists but high for many other schools. The educator is concerned with how to develop relevant skills, leaving to others the comparative emphasis upon or choice among them. But, of course, he must still decide what skills are most likely to be relevant.

Yet one may ask whether in the training for understanding, if not for production, standards of taste will not have to be imparted. The answer has several parts. In the first place, any attempt to indoctrinate any standards as absolute and universal is indefensible. A reading of the damning comments, by critics of their time, on Rembrandt or Brahms or many others among the greatest figures in the arts should destroy any confidence in authoritative current evaluation of contemporary work. Moreover, "Gothic" and "primitive" were once widely accepted terms of opprobrium. On the other hand, expert judgment of the comparative merit of works within (but not across) the production of a particular well-known earlier school or artist are more useful. Training in these judgments and how they are made may improve understanding in two ways. First, responsible judgments of merit often serve as incitement to discover differences that had gone completely unnoticed (Goodman, 1968, mentions this); thus aesthetic evaluation serves as a prelude to rather than the goal of deeper understanding. Second, exposure to critical judgments within different schools or cultures or by different artists may make the student aware of alternatives to whatever standards have imprisoned him, without giving him the impression that quality does not matter.

Thus the educator and the investigator of education in the arts need neither adopt any absolute aesthetic standards nor abandon all hope of evaluating their own work.

4.2 Practice

The consultant in the field, faced with the task of evaluating educational ideas, programs, and methods will not find in our theoretical analysis a prescription for just how to proceed. His normal first step will be to try to determine the acknowledged objective; and to attempt an evaluation only insofar as that objective is improvement of production and understanding in the arts. Then, or concurrently, he will survey the situation with all the knowledge, sensitivity, taste, and good judgment at his command. Despite our strictures against applying any aesthetic standards as absolute, he will not hesitate to make his own judgment on the quality of any work produced; (and incidentally, judgments that particular works produced within given restrictions are bad have a comparatively high degree of reliability).

This initial informal appraisal he will take as a preliminary to a

more systematic investigation. He will use a theoretical analysis, such as we have set forth above, in testing his judgments, in probing beneath and beyond them, in asking himself critical questions. To what extent is the quality of work immediately produced a measure of the success of this particular program? Does the program have, or should it consider having, the training of skills towards future production or eventual understanding as its major goal? What skills are most needed for the art or phase of art in question? How effective are the methods used for developing such skills? Are some more important skills overlooked? What alternatives may be suggested in formulation of goal, in choice or balancing of component factors?

In particular, the evaluator will also try to differentiate between those virtues and defects that do and those that do not depend primarily on the particular people involved in the program. The gifted educator in any field is an irreplaceable asset, and the inept educator a heavy liability. But the personnel in almost any program changes frequently; and the evaluator's primary concern is with measures that may maximize the good educator's effectiveness and minimize the poor one's shortcomings.

Judgment of success or failure is the beginning rather than the end of the evaluator's responsibility. What he should provide are suggestions toward making improvements; toward correcting deficiences and strengthening virtues of the program. And he will keep in mind the chastening lesson of the Hawthorne effect, that a poor program may often be better than none.

CHAPTER 8. CONCLUSIONS

Our task has been to investigate basic abilities involved in understanding and creation in the arts, with a view toward eventual improvement of education for both artists and their audiences. We had to begin far back by considering such matters as the very character and function of the arts, the concept of 'abilities', the objectives of education in the arts, and even the nature of education itself. Our study has been multifaceted, interdisciplinary, and exploratory, and does not lend itself to summary in sweeping conclusions or firm recommendations. Furthermore, conclusions and recommendations are the least important part of a report on the early phases of a long range basic research program. All we can do in closing is to indicate some of the main directions of inquiry as suggestions for consideration by those concerned with education for the arts. What follows is not a complete or detailed summary, but rather a partial and somewhat differently organized reminder of what has already been summarized.

1. Ground Clearing

a. Education for the arts is hampered by prevalent conceptions of them either as mere instruments of amusement or as requiring justification in terms of something else. Artist and educator are beset simultaneously by denigration of the arts as frivolous and by over-reactive attempts to show how training in the arts contributes to proficiency in other pursuits.

b. Production and understanding in the arts involve human activities that, though they differ in specific ways among themselves and from other activities, are nevertheless generically related to perception, scientific inquiry, and other cognitive activity. This is more often than not obscured by a tangled mass of popular and professional prejudices, confusions, attitudes, that undermine any intelligent effort at improvement of arts education. These range from the infiltration of philosophical fallacies concerning givenness and immediacy to the exaltation and isolation of the arts as accessible only to inexplicable inspiration.

c. Education for the arts consists in discovering or inculcating, and fostering the abilities appropriate to the specific activities involved. Any serviceable analysis of abilities must recognize a spectrum running from such very special skills as fingering a musical instrument to such complex functions as organizing mastered special skills for the solution of a difficult problem. And any particular taxonomy of abilities should be taken not as a description of fixed 'faculties' but as a useful tool.

d. 'Creativity' is neither peculiar to the arts nor the sole or comprehensive concern of education for the arts. Exclusive attention to 'creativity' has often obscured the importance of the several skills that creation in art -- or in science -- must employ, and sometimes inspires an awe that discourages educational efforts.

e. Education is not to be identified with scholastic instruction, but the varied methods employed in the workshop, on the athletic field, in vocational training, and in the studio need to be studied for their applicability in developing specific abilities related to the arts. The persistent notion that 'the arts cannot be taught' and that research into arts education is therefore pointless has its roots in a narrow view of education as classroom teaching and is as misguided as supposing that tennis or bicycle riding cannot be taught.

f. Evaluation of methods and programs should be based as far as possible on whatever knowledge we can obtain about the functioning of human beings in relation to the tasks required in understanding and production in the arts rather than on judgment of the works themselves. Caution against hasty conclusions concerning the success of any educational program in the arts is counseled not only by the long time required for realization of the effects of such a program and the extreme difficulty of maintaining any adequate experimental controls, but also by the notorious volatility of aesthetic standards and the deceptive operation of the Hawthorne effect. Moreover, the unfortunate emphasis on 'appreciation' rather than understanding reflects a disturbed view of aesthetic experience as directed toward a kind of grading, and of education for the arts as a matter of indoctrinating the teacher's own aesthetic standards.

2. Theory

a. Since education depends upon transfer of learning from one task to another and from one type of task to another, we need an analysis of types of tasks and of skills required to perform them, based upon likenesses and differences that may facilitate or hamper such transfer. Adding a column tends to improve the ability to add other columns, practicing scales to improve the ability to perform sonatas, doing roadwork the ability to play football, repeating a list in one language the ability of a bilingual subject to repeat it in another language. But the systematic study of the dynamics of enhancement and interference among skills required in the arts must begin with an examination of significant principles relating, for example, problem solving tasks to other work, and comparatively simple skills to each other and to more complex abilities.

b. Since many tasks in the arts, like many in science and daily life, involve the processing (i.e. identification, application, interpretation, revision, invention) of symbols, a study of symbolic systems may provide clues to significant relationships among tasks and to the consequent transferability of learning between skills. The pertinent differentia among such familiar systems as those of natural and computer languages, pictures, diagrams, maps, facial expressions, and gestures need to be made explicit.

c. Five conditions -- two of them syntactic, three semantic -- for a system to be truly 'notated' in a definite sense provide the means for a basic classification of all symbol systems according to which among the five conditions are satisfied. Standard musical notation,

somewhat modified, comes near to satisfying all the conditions; languages meet some but not others, pictorial systems meet few if any.

d. Symbols belonging to a system of any of these types may refer in one or some of several different ways; for example, they may denote as do verbal descriptions and pictorial representations, they may exemplify certain of their literal properties as do tailors' swatches, or they may express certain of their metaphorical properties, as symphonies may. Thus denotation, while including representation as well as naming and predication, is narrower than reference, which includes also exemplification and reference (among other relations).

e. Misunderstood or overlooked -- but psychologically and educationally important -- likenesses and differences among various verbal systems and among skills required for working with them are clarified in terms of this theoretical analysis. The often mentioned but little studied distinction between linguistic and non-linguistic systems is now defined, so that attention can be focussed on vital neglected features of the non-linguistic systems prominent in many of the arts. Common confusions concerning "iconic" signs, representation, and expression are undermined; and a supposed gulf is bridged by disclosure of significant affinities between certain artistic and certain scientific skills.

* * * * *

The above preliminary and theoretical work provided general guidelines for the special investigations of abilities in relation to the arts; but the choice of particular studies within these boundaries depended upon the facilities available to us and the interests of staff members and comparative consultants. These studies do not make up an integrated and comprehensive whole but are diverse and exploratory soundings of the territory. They may eventually lead to recommendations running all the way from reformulation of the entire educational program so as to give more scope to the development of abilities pertinent (but by no means confined) to the arts all the way down to changes in the procedures for training in special phases of particular arts.

Among the studies described in the body of this report, some (III below) concern general types of abilities and their interrelation, while others (IV) deal with specific abilities prominently involved in the arts.

3. General Studies

a. The analysis of symbol systems and functions was applied to the classification of abilities, thus providing new means for interpreting data, correlating evidence from diverse observations and inquiries, and designing experiments concerning transfer and interference among skills.

b. A correlative taxonomy of scholastic and non-scholastic means of inculcating or fostering skills was developed as a preliminary t

exploring the special effectiveness of many non-scholastic methods, such as coaching and demonstrating, in the development of skills involved in the arts.

c. Psychologically and educationally important experimental and work on the differential impairment of skills under various types of brain damage was intensively studied. Consideration of current work in this field in the light of the theory of symbols resulted in illuminating and rapidly developing hypotheses concerning the nature and basis of kinships and divergences among abilities to perform linguistic and non-linguistic, novel and familiar, short term and long term tasks. Unexpected cases of dissociation of apparently similar skills were examined. Attention was increasingly focussed on the importance of developing the traditionally neglected functions of the right hemisphere of the brain.

d. We studied the question how problem solving is distinguished from routine tasks, with special attention to understanding the nature of problems in artistic production and comprehension, and the role of problem solving in the arts. The ways and the importance of mastering, integrating, and revising or breaking routines in the advancement of aesthetic ends was examined, as were the kinds of strategies appropriate for dealing with symbol systems of various kinds.

4. Studies of Specific Abilities

a. Experiments were conducted to explore the ability of children at various ages to discover, or to learn to discern, stylistic likenesses and differences -- in literature, in painting, in music -- that cut across classification by subject matter. The ability to reorganize experience by the recognition or construction of such complex and unfamiliar patterns as features of style seems essential to understanding in the arts. Radiation of the effect of training in style recognition calls for further study.

b. Experimental studies were made of abilities to detect and to reproduce rhythmic patterns, independently of differences in pitch, instrument, etc. As a preliminary to our experiments, the concept of rhythm and of identity of rhythmic pattern had to be analyzed, and means of recording rhythmic patterns had to be developed. The ability to discern community of rhythm under drastic variance in other attributes seems, like the ability to discern community of style, a highly characteristic aspect of the kind of pattern recognition involved in the arts.

c. Various experimental investigations were made of visual perception as a constructive activity; e.g. (i) how simple configurations of straight lines are taken as representing solid objects, (ii) constancy and change under variation in angle of viewing of pictures, (iii) motion perception resulting from discrete static stimulation -- a study of the elaborate ways the visual system supplements stimulation to create intelligible patterns of continuous motion.

d. Miscellaneous other studies concerned such matters as (i) recognition of subject in caricatures, exploring the effect of certain calculated distortions of the customary mode of representation, and (ii) perception of relief pictures by touch, bearing on the important general question of how information and other features may be independent of particular medium.

* * * * *

Along with the theoretical and experimental research outlined above, we have maintained close contact with the arts and arts education in actual practice by close observation and participation in the field.

5. Field Work

a. Visits were made to colleges, conservatories, and art schools to observe and compare actual policies and procedures, and to study differences in problems and approach, with respect to the arts, between academic institutions and professional schools.

b. 'Alternative' schools were visited and studied to observe the operation of various 'progressive' philosophies and methods so far as the arts are concerned.

c. We cooperated in planning, founding, and teaching in an institute for arts management, with the conviction that education in efficient and aesthetically sound management is essential to the advancement -- or even the survival -- of the performing arts.

d. We planned and produced a series of performance-demonstrations and lecture-demonstrations in most of the arts as means of audience education -- that is, of improvement of understanding of and interest in the arts by laymen -- and as a means of observing at first hand art in the process of its making by professional artists.

* * * * *

As a result of our studies, what counsel can we offer the arts educator? We certainly cannot presume, at this stage of a program of basic research, to tell him what to do. We write no recipes, but we hope that he may find in the foregoing studies some material that will be of use in his own thinking and practice.

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APPENDIX 1

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APPENDIX 2

PROJECT ZERO PUBLICATIONS

Technical Reports

1. Vernon A. Howard, Harvard Project Zero: A Fresh Look at Art Education

2. Barbara Leondar, The Arts in Alternative Schools: Some Observations

3. Howard Gardner, The Development of Sensitivity to Figural and Stylistic Aspects of Paintings

4. Howard Gardner, Three Studies of Perception of Artistic Styles

5. David Perkins, Geometry and the Perception of Pictures: Three Studies

6. Vernon A. Howard, Types of Musical Reference: Three Philosophical Essays

7. Frank L. Dent, The Lecture-Performance: An Instrument for Audience Education

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