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Barbara Ruth Hiranpradist

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Robert L. Eckhardt
Major professor

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FORMAL OPERATIONAL THOUGHT AS A DIMENSION OF MUSIC LISTENER BEHAVIOR

By

Barbara Ruth Hiranpradist

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ABSTRACT

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OF MUSIC LISTENER BEHAVIOR

By

Barbara Ruth Hiranpradist

Piaget, in discussing the formal operational stage of cognitive development, stressed the need for educators to promote hypothetico-deductive reasoning in specific content areas. Formal operational activities, which reflect the analysis of a process as well as a product, generally consume valuable instructional time and are often ignored by educators despite their salutary effects.

The problem of the present investigation was fourfold: (a) creation of an aural musical analysis task requiring deductive reasoning for its completion, (b) evaluation of 72 university music and nonmusic major subjects between the ages of 18 and 22 years on selected formal operational criteria, (c) analysis of centrational/decentrational listening strategies, and (d) analysis of selected learning style preferences as they related to the completion of the Melodic Strategram software.

The contrived Melodic Strategram software consisted of four aural musical tasks, each requiring the same deductive reasoning process. The subjects were requested to identify a melody that sounded least

like the comparison melody and to verbally discuss their listening strategy as they progressed through each task. The data-gathering protocol developed for this phase of the study provided categories for specific formal operational criteria.

While established cognitive styles are a popular focus of current research in music, learning styles--a more freely defined term that includes a mélange of interpretations--was a secondary consideration of this study.

A synopsis of the results include:

1. The problem-solving strategies of the majority of music major students were congruent with the formal operational criteria adopted for this study, as well as with prerequisite Piagetian constructs.
2. The problem-solving strategies of the nonmusic major students reflected deficiencies in formal operational approaches with a propensity toward more primitive types of strategies.
3. The preferred music listener learning styles of the music and nonmusic majors differed in the areas of verbalization, decision making, computer originated music, and task difficulty.

The investigation concluded that a Piagetian-type aural musical analysis task was indeed a challenge to music and nonmusic majors alike. The differences revealed in the problem-solving strategies and listening style preferences of the music and nonmusic majors may have ramifications for improving music instruction.

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CHAPTER I

BACKGROUND

Introduction

The investigation of musical concept formation and problem-solving strategies has engaged the energies of music researchers during the latter half of this century with the goals of improving both the process and product of instruction in music education. Questions raised include why, when, and under what specific conditions musical concepts develop. This current tendency had its genesis in aural perception and discrimination from purely a musical or psychometric standpoint (Seashore, 1919), and has matured to include interpretations through established constructs in the field of developmental psychology.

Accepting Mursell's (1937) premise that the brain and not the ear organizes music, a large contingent of music researchers have adopted a cognitive developmental approach to music learning as opposed to a behavioristic interpretation. These two schools of psychological thought diverge in their emphasis on the roles of the external versus internal determination of behavior.

Gardner (1985), in his speculative discussion of multiple intelligences, stated that links, perhaps tenuous, are found between various aspects of music and properties of other cognitive systems. Two of the more promising contemporary theories, upon which current

music research has been based, are those of Jerome Bruner (Bruner, Goodnow, & Austin, 1956) and Jean Piaget (1950). Bruner, through his simultaneous and consecutive scanning paradigm, and Piaget, with his concrete and formal operational stages of development, have each addressed the issues of concept development and hypothesis testing.

The aforementioned theories have also served as an impetus for clinical research with the aim of revealing the nature of the cognitive processes across a variety of disciplines. Piaget's formal operational construct of combinatorial logic provided the foundational theory for the present study.

Piaget and His Theory

Piaget's position in developmental psychology (Labinowicz, 1980) is unique in its orientation and in its direct opposition to the behaviorist position upon which much of American psychology is based. Although both theories have roots in biology, traditional behaviorism holds that stimuli from the external environment produce predictable, immediate responses in animals and humans; thus, its goal was to attempt to predict and control behavior. Piaget, however, maintains that man's responses to stimuli are much less predictable and that an individual has the ability both to choose his responses and to initiate changes in the environment. In his view, the major focus regarding human behavior is on the intermediary processes between stimulus and response, the internal workings of the mind that can substantiate observable behaviors.

From the Piagetian standpoint (Inhelder & Piaget, 1958), cognitive development resembles a stage of flux, with interaction between the human being and his environment becoming the arbiter of knowledge growth. This development encompasses the early psychomotor activities of the infant and extends to the internalized logical processes of the adult.

- Piaget's theory outlines four main invariant stages of development that extend over the period from birth to maturity: (a) sensorimotor, 0-2 years; (b) preoperational thought, 2-7 years; (c) concrete operations, 7-11 years; and (d) formal operations, 11-15 years. These stages of intellectual development, based on an invariant sequence of evolving mental structures, offer a guide of approximate age-related cognitive abilities that contribute to the understanding of logical thinking in a multitude of academic areas. A detailed discussion of Piaget's stage theory is taken up in the review of literature section of this study.

Aural Musical Analysis Within the Piagetian Context

Rogers (1984), in his authoritative overview of philosophical pedogogies in music theroy, stated that analysis and meaningful listening are musical skills totally dependent on the ability to conceptualize what is heard. Implying the hypothesis testing aspect of musical analysis, Rogers offers the employment of the following strategies: (a) explanations, (b) connections, (c) relationships, (d) patterns, (e) hierarchies, and (f) comparisons. Using all of the above, while engaged in a deductive discovery of similarities and differences in

a micro-musical dimension, this research project addressed theme and variation audition, as interpreted through the construct of conservation.

Conservation, the consummate cognitive attainment of the stage of concrete operations, has been the most prolific focus of Piagetian research in music. From a conceptual standpoint, aural conservation research has sought to determine a congruence of ideology with the original Piagetian tasks. The tasks were based on the ability to trace visual changes in concrete matter (clay, water, etc.) and to determine if the changes produced an entirely different entity. The key ingredient was the ability to "reverse" a given action, a cognitive thought process. Conservation research in music has been successful in providing music educators with a closer look at how one aurally holds an element(s) of music invariant while attending to conceptual changes in the original stimulus.

The theme and variation paradigm was adopted by Zimmerman (née Pflederer, 1964) in her aural pilot conservation study involving 5- and 7-year-old children. Synonymously, Zimmerman and others used the monikers "deformation" and "transformation" to designate theme and variation. The theme and variation model has served as the foundation for numerous musical conservation studies due to the ease of musical element stratification and identification.

Frequently associated with the formal operational level of thought are such terms as (a) problem solving, (b) systematic procedures, (c) hypothesis testing, (d) divergent thinking, and (e) logic. The

commonality inherent in these terms is the process-oriented approach rather than that of product. The cognitive processes are no longer bound to the real world, but are emancipated to consider all possible variables in problem solving through controlled experimentation and logical analysis. The results are the availability of a wide variety of choices that foster flexibility of thought.

Formal operational thought has posed a problem to music researchers and has left a void in musical interpretations as well as in other disciplines. In the two existing investigations, Larsen (1973) researched the dual aspects of reversibility of thought and hypothesis testing, while Cutietta (1982) specifically highlighted hypothesis-testing strategies. A more detailed account of these two investigations appears in Chapter II.

Tangentially related to the present study, Haack (1969) found that the analytical-deductive approach to thematic development techniques in perceptive listening skills yielded highly significant gain scores in high school students. Employing a problem-solving teaching approach, Eisman (1975) found it to be as equally effective as a lecture-demonstration approach.

Warrener (1985), in his practical outline of Piagetian musical inferences, reaffirmed the role of deductive, logical musical analysis and referred to the formal operational period as "knowledge in action." The author also stressed the modification of current teaching approaches to assist in formal operational acquisition.

State of the Science in Formal Operational Research

Problems associated with formal operational assessment include: (a) the difficulty of adolescent and adult monitoring of reasoning replies (Piaget, 1970); (b) the establishing of relevant tasks in specific subject areas reflecting one or more of the constructs of formal operational thought (Kuhn, 1979, cited in Vuyk, 1981); and (c) the recognition of the fact that not all adults acquire formal operational thought even though it is available to all normal adolescents and adults, with success usually limited to a specific domain (Inhelder & Piaget, 1958).

Some additional, general comments on the attainment and measurement of formal operational abilities should be considered. Piaget (9170) stated that formal structures are not totally a matter of cognitive maturation, but are contingent on the factors of (a) social transmission, (b) a stimulating environment, (c) motivation, and (d) appropriate neurological development. He also stated that the speed of development can vary from individual to individual and from one social environment to another.

Staver (1984) had identified a controversial issue pertinent to the measurement of Piagetian reasoning patterns, specifically the content-free idea. He explained possible failure of formal operational tasks in terms of "resistance" to assimilation, resulting in the phenomenon of horizontal décalage. This essentially means a "delay" in development at a certain level of cognition in a few, but not all, content areas.

In his discussion of formal operational thought, Piaget (1958) originally stated that form was independent of content. Shortly before his death, he revised and communicated this new insight in talks with Vuyk (Vuyk, 1981) that form was relatively independent of content. Kimball (1976) echoed Piaget's revision and added that another important aspect of formal operations is that the person generates a predetermined plan of action and essentially uses the content or objects to confirm his plan.

Although Piaget was concerned with content-free structures, Staver stated that factors such as: (a) factual knowledge, (b) uniqueness of formal reasoning, (c) working memory, (d) learning style, and (e) sex differences are influential. In constructing formal operational assessments, Staver further recommended: (a) the avoidance of taxing the working memory, (b) the use of task analysis, (c) the use of concrete materials to introduce abstract ideas, and (d) the arousal of cognitive conflict.

Bart (1971) was also preoccupied with the bi-factor (form and content) status of formal operational thought and stated that the separation of these factors is difficult at best, but success can be achieved if one adheres to a single content area.

Problem

The immediate problem under investigation in this study was the creation and administration of an aural musical task that would evoke and sustain, to some degree, the Piagetian construct of combinatorial logic. Although the deductive reasoning process used in this study

was not totally congruent with an established Piagetian task, the aim of this researcher was to subject university-aged students to a rigorous mental and aural exercise requiring some form of logical analysis. It was this researcher's intent to measure, through a self-report and empirically scored protocol, the problem-solving strategies exhibited by a sample of college-aged music and nonmusic major students. Problem-solving strategies in this study were equated with hypothesis testing, in which subjects were to have exhibited the systematic generation, isolation, and combination of the specific musical variables (elements or concepts) of mode, rhythm, and tempo.

Piaget's discussion of formal operational abilities relies heavily on "formal logic" where the combinatorial system is said to have a lattice structure (N x N combinations). The following example (Stephens et al., 1977) illustrates the lattice structure in the consideration of variables.

Verbal Proposition: A person went to a country in which the only vehicles were cars or trucks. The only fuel was diesel or gasoline. What would be all the various ways of classifying these vehicles?
(2 dependent variables x 2 independent variables).

1. No cars and no trucks.
2. Only cars which use gasoline.
3. Only cars which use diesel.

4. Only trucks which use gasoline.
5. Only trucks which use diesel.
6. Cars and trucks which use gasoline.
7. Cars and trucks which use diesel.
8. Cars which use gasoline and trucks which use diesel.
9. Cars which use diesel and trucks which use gasoline.
10. Only cars which use diesel or gasoline.
11. Only trucks which use diesel or gasoline.
12. Cars which use diesel and gasoline and trucks which use only diesel.
13. Cars which use diesel and gasoline and trucks which use only gasoline.
14. Trucks which use diesel and gasoline and cars which use only diesel.
15. Trucks which use diesel and gasoline and cars which use only gasoline.
16. Cars which use diesel and gasoline and cars which use only diesel (pp. 52-53).

(See Appendix A for three additional examples of Piagetian formal operational tasks.)

Piaget (1958) stated that the combinatorial system becomes an instrument of "conclusive deduction," more powerful as a teacher than inductive reasoning. Piaget and Inhelder (1969) stated that in order to determine which operations are possible, a person proceeds to experiment actively with all the combinations and to note the results.

Ennis (cited in Vuyk, 1981), in a critique of Piaget's lack of "clear" criteria for determining whether or not adolescents do work within the combinatorial system, prefers the phrase "working within the combinatorial system." Bynum et al. (cited in Vuyk, 1981) argued that Inhelder's and Piaget's claim that all sixteen binary operations can be found whenever one exhibits formal operational reasoning is not a reliable indicator as specific Piagetian protocols (task analyses) indicate considerably less than the sixteen. This essentially means that all of the possible combinations in a specific testing situation may not be formed or deliberated upon. The power of reasoning is not diminished. It probably occurs as a result of a subject's processing, but not verbalizing, specific factual information.

Ginsburg and Opper (1969) stated that the model of the sixteen binary operations is actually a special case of a larger and more comprehensive combinatorial system. The task utilized in this researcher's experiment reflected such a case. One dependent and six independent variables were represented. Through factorial analysis, a table of probabilities was constructed in order to arrive at a combinatorial lattice. The total number of combinations terminated at sixty-four, but scrutiny of the table (Appendix B) shows that a sizeable portion of the probabilities do not conform to the reality of the task. For example, the task melody could not possibly be in the major mode and in the minor mode at the same time.

This researcher, in an attempt not to deviate from the established model of previous conservation research, incorporated the theme and

variation aspect into the tasks contrived for this investigation. To assist the reader in a Piagetian interpretation of this study's task structure, an index of Piagetian task inferences is presented in Appendix C. The strategies adopted by the subjects were the procedures through which they arrived at their answers (correct answers were not an integral part of the formal operational assessment, but viewed as a subproblem) to the following question:

Given a short, four-measure phrase and eight comparison phrases varied by rhythm, mode, and tempo, either singly or in combination with each other, the subject was to identify the melody that sounds least like the original. By creating a task of this sort, a state of cognitive conflict was produced through conservation by negation. Building on the established conservation model, but employing the negation approach, the task of this study was to evoke the combinatorial system while interacting with aural musical variables. One who completed the task would either consciously or unconsciously process most, but probably not all of the probability matrix presented in Appendix B.

This researcher's primary focus was to measure, via a clinical interview, the degree of formal operational functioning exhibited by university music and low-experienced nonmusic major students. The protocol criteria were derived exclusively from Piaget's formal operational stage of cognitive development.

Subproblems

The aforementioned problem created the following subproblems:

1. What was the most commonly employed listening strategy used by music major and nonmusic major students?
2. To what degree were the correct answers obtained by both music and nonmusic majors?
3. Will ANOVA reveal any significant differences or interactions between the formal operational scores of music major and nonmusic major students and the Music Listener Learning Style Inventory?

Definitions

Melodic Strategram: The Melodic Strategram was the title adopted by this researcher for the aural Piagetian computer program.

Conservation by Negation: A negative test question stem is frequently referred to as confusing if not sufficiently highlighted (Sax, 1974), but not all authorities agree. Educational Testing Services (1983) holds the position that test question stems featuring the words "not," "least," or "except" are used for a purpose, that purpose being to summon a different, more analytical thought process. In this experiment the denouement of the Melodic Strategram was to conserve by negation, or to identify the melody that sounded least like the original comparison melody.

In this research, conservation by negation required subjects to conserve single, double, and triple variations as alterations of the original melody through the process of negation.

Centration: Piaget (1952) discussed centration in the role of perception with reference to "elementary error I," or overestimation of a stimulus, and disclaimed centration as a preferable task strategy. While centrating, a person is unable to view objects or events from a variety of perspectives. Centration is also discussed in "elementary error II," or error of the standard. This arises when a subject is asked to compare objects, one of which is left in place (in this study, the original melody) while others are presented one at a time (variations). The standard is systematically overestimated as the subject keeps returning to the standard to make judgments. Centration is the prevailing perceptual orientation of the preoperational stage.

Decentration: Piaget (1952) referred to decentration as an ontogenic phenomenon. A person who functions in a decentrational mode explores all elements of a stimulus. Decentering assumes a very important position in Piaget's theory, both perceptually and cognitively. Whereas centration leads to errors, decentration provides correction and regulation which eventually promotes equilibrium. Decentration is most commonly observed in persons who are functioning at the concrete and formal operational levels.

Hypothetico-deductive Reasoning: According to Piaget and Inhelder (1969), hypothetico-deductive reasoning is a form of logic that results in a disconnection of thought from objects. It frees relations and classifications from their concrete or intuitive ties and is frequently referred to as the "classification of all classifications." This liberation of form from content allows one to establish any desired relations of classes that are desired by bringing together

any elements, singly or in multiples, that combine objects with objects, factors with factors, or ideas with ideas when reasoning about a new reality. This basically reflects a deductive manner of thinking.

Systematic Strategy: A systematic strategy was reflected in a subject's ability to exhibit some organized procedure or anticipatory schema in music variable isolation and verification. To quality for exhaustion of all the variables, the subject verbalized singly or in combination (nonmusical terms were accepted as long as the words or phrases chosen reflected the concepts) variables indigenous to each task.

Nonsystematic Strategy: A nonsystematic strategy was evident in a subject's inability to exhaust all variables, both singly and in combination. Random or trial and error listening strategies also qualified as nonsystematic.

Single Variation: Single variation in the present study referred to a single variation of the task melody, either rhythm, mode, or tempo.

Double Variation: Double variation in the present study referred to a double variation of the task melody, either rhythm/tempo, tempo/mode, or mode/rhythm.

Triple Variation: Triple variation referred to a triple variation of the task melody, in this study there being only one, rhythm/mode/tempo.

Absence of Formal Operational Thought: To qualify for the category of "absence of formal operational thought," a subject

exhibited three out of four of the ensuing behaviors: (a) no statement of strategy on how he is going to proceed in solving the musical task, (b) the inability to isolate more than one of the three variables of rhythm, mode, or tempo, (c) the inability to experimentally exhaust the eight melodic choices (state the variables indigenous to four separate melodic choices in the computer task), and (d) the inability to verbalize not more than four of the eight melodic choices.

Intermediate Formal Operational Thought: To qualify for the category of "intermediate formal operation thought," a subject exhibited three out of four of the ensuing behaviors: (a) a statement, either unsystematic or vague, on how he thinks he is going to proceed; (b) the ability to isolate at least two out of the three variables of rhythm, mode, or tempo; (c) the ability to experimentally exhaust all eight of the melodic choices; and (d) the ability to verbalize more than four, but less than eight, of the melodic choices.

Absolute Formal Operational Thought: To qualify for the category of "absolute formal operational thought," a subject exhibited three out of four of the following behaviors: (a) a clear, systematic, statement of how he is going to proceed to solve the task; (b) the ability to isolate all three of the musical variables or rhythm, mode, and tempo; (c) the ability to experimentally exhaust all eight of the melodic choices; and (d) the ability to verbalize all eight of the melodic choices.

Assumptions

This study assumed the following conditions that would directly influence its efficacy in aural concept development and hypothesis testing.

Assumption 1: The population chosen for this investigation is representative of similar student populations throughout the nation.

Assumption 2: The contrived task will evoke and require some degree of logical thought.

Assumption 3: There will be apparent differences between the problem-solving strategies of music and nonmusic majors.

Assumption 4: The developed computer program will adequately allow for ease in task completion.

Assumption 5: The task reflects the Piagetian theory of interactional learning and functions as an experimental control in task administration.

The researcher also assumed, in the absence of a separate measure of aural perception, that university music majors, and elementary education majors with at least one term of music fundamentals but no other formal music training would be able to perceive differences in melodies that are varied by rhythm, mode, and tempo.

Limitations

This investigation was limited to the following conditions: (a) male and female volunteer music major/elementary education majors between the ages of 18 and 22 years, (b) aural musical tasks with no

visual cues or aids, (c) musical phrases composed by this researcher, (d) an investigation of the combinatorial logic aspect of formal operational thought only, and (e) the individual expressive verbal abilities of each subject in a self-report interview situation.

Need for the Study

The paucity of formal operational studies in music reflects the difficulty and challenge presented to music researchers to construct musically valid analogous tasks through which some degree of hypothesis testing can be measured. Kimball (1976) suggests the vagueness of Piaget on this particular level of thought might be at fault. Research in the disciplines of mathematics, science, and linguistics has yielded some conclusions as to the lack of attainment or desire to function at the formal operational level. This information has assisted in the reevaluation of the discovery versus the expository mode of learning.

As the existing musical studies purporting a formal operational component have not dealt with persons past the incipient developmental period for formal operational reasoning, this researcher chose university-aged students as the target population. Kohlberg and Mayer (1972) stated that the development of formal operations can and does continue much beyond the age of fifteen and the variability rate of acquisition is greater than that of the earlier stages since the stage is the least automatic of all growth periods. The authors claim that human beings can exist an entire lifetime without acquiring

formal operational abilities, possibly as many as 50% of the American adult population.

Piaget (1972) stated that all individuals attain formal operations, but perhaps only in areas with which they have had much experience. Wadsworth (1978) adds that in primitive cultures formal operations are rarely seen as that form of reasoning has little adaptive value within such societies.

Restaino (1978) observed that the combinatorial level of formal operations is required as early as the fourth grade and success is contingent on the students' ability to organize the elements of each experience and are mastered over long periods of time. The author considers that some task variables make a task harder to function at the formal level, resulting in horizontal decalages. Restaino also proposed that formal operational performance is a consequence of (a) the amount of information to be processed in one operation in the short-term memory, (b) task variables, and (c) processing schemes, all of which are a part of the sequence in the problem-solving procedure.

Marsh and Loseke (1978) stated that instructors must be aware of cognitive chasms when teaching students who are close to their own age chronologically, but in essence, are at a totally different developmental level. They cited that Neimark's (1975) review of literature on formal operations indicates that the stage is not universally attained prior to age 18 in our society, emphasizing the more common existence of bi-modal student populations. After administration of

a valid group test for formal operations to psychology and science majors, Neimark concluded that (a) mean performance was at the late concrete stage, (b) the ability to respond correctly on a single problem when led through it step-by-step by the instructor did not always lead to transfer of the solutions to new problems of a similar type, and (c) college instructors should structure the curriculum both concretely and in abstract terms with emphasis on the nurturing of formal operational abilities.

With little dispute, music educators concur on the important role of aural musical abilities in the career success of music major students. As an integral component of the university elementary education majors' curricula, a course in the fundamentals of music is offered with objectives and expectations qualitatively not unlike those required of the music major. Concern for instruction of non-music majors has been expressed by Willoughby (1982) at the Wingspread Conference on Music in General Studies:

> The nature of the musical experience is essentially the same for everyone. Whether through composing, performing, or listening, the differences in experience for the music major and for the consumer (nonmusic major) are a matter of degree, not of kind (p. 54).

An additional consideration regarding the musical ability or inability of nonmusic majors enrolled in service courses is the advent of minimum competency music requirements presently enacted by an increasing number of states.

The present investigation was intended to function as a pilot study in Piagetian evaluation with implications for further assessment

in other content areas. Computer Assisted Instruction is currently applied in many areas of music, but a program that reflects a specific Piagetian construct is not extant. The computer software created in this study suggests usage not only as an assessment tool, but could serve as an aural readiness activity for in-depth musical analysis, or a teaching device in both music and nonmusic courses with content adjustment embracing a variety of objectives.

CHAPTER II

RELATED LITERATURE

Overview

The ensuing discussion of related literature is organized in the following manner: (a) Jean Piaget and his theory, (b) genetic epistemology, (c) Piagetian constructs, (d) Piagetian stage theory, (e) Piagetian research in music, (f) the role of the microcomputer in music education, (g) learning style relevance in knowledge acquisition, and (h) conclusion.

Jean Piaget and His Theory

Jean Piaget (1896-1980), a native of Geneva, Switzerland, was a representative of the cognitive school of developmental psychology, but his only university diploma was in the area of zoology. Gruber and Vonèche (1977) stated that Piaget possessed two dominant preoccupations: (a) the search for the mechanisms of biological adaptation, and (b) the analysis of a higher form of adptation which is scientific in thought. The latter aim deals specifically with genetic epistemology, a branch of philosophy that considers both the formation and meaning of knowledge.

It was through children, initially his own, that Piaget evolved a theory based on the qualitative development of intellectual structures. Utilizing only verbal questions and answers in his incipient

work, Flavell (1963) remarked that Piaget progressed to an approach used extensively in his subsequent investigations: (a) the presentation of some kind of task to which the child makes a response, (b) interrogation by the investigator, and (c) the presentation of a variation of the problem, or new stimulus. The process continues in the same manner, each successive response by the child being a partial determinant of the experimenter's adoptive interview strategy. Referred to by Piaget as méthode clinique, the primary purpose of this research technique is to explore a diversity of child behaviors in a stimulus-response-stimulus-response sequence. Success of the method is contingent upon the insight and ability of the experimenter.

Gruber and Vonèche (1977) stated that the works published by Piaget and his associates constitute the largest repository of knowledge regarding the cognitive development of children that is available anywhere; a reposition that is still incomplete. Piaget's total output includes more than 50 books and monographs and hundreds of articles published over a 70-year period.

Piaget's work was, and still is, currently being perpetuated at the Centre International d'Epistémologie Génétique in Geneva. At the Centre, founded in 1955, Piaget selected a topic yearly to be investigated. Through a process of discussion, the details of up to 20 different experiments were formulated from each topic. A symposium was held at the end of each academic year where the same work was presented once again and discussed with a group of invited participants. Following the symposium, Piaget assumed the task of the final synthesis of the discussion and empirical research.

From his extended work and research came many awards from the profession. Modgil and Modgil (1976) stated the following honors: (a) multidisciplinary university chairs, (b) the 1969 Distinguished Scientist Award from the American Psychological Association, and (c) the directorship of UNESCO International Bureau of Education since 1929. Three American institutions that have sponsored organizations dedicated to the perpetuation or revival of Piaget's theoretical research include Cornell University, Ithaca, New York; Temple University, Philadelphia, Pennsylvania; and the University of Southern California, Los Angeles, California.

Clarizio (1982) stated that the credibility of Piagetian theory can be witnessed in the incorporation of Piagetian-based scales in psychological testing and measurement. The following have made this effort in order to provide an alternative to traditional intelligence testing: (a) the British Intelligence Scales, (b) the University of Montreal, and (c) the New York City Board of Education.

Genetic Epistemology

Piaget (1970) and Inhelder (1962) stated that genetic epistemology is concerned with the scientific consideration of the genetic laws that undergird knowledge development and change. Research work in the field sought to analyze the mechanisms of knowledge growth insofar as it pertained to scientific thought and how these mechanisms pass from states of least knowledge to those of the most advanced. Furthermore, categories and concepts of established science, such as those

of space, time, causality, number, and logical classes have been studied as they develop in the life of a child.

A continuing controversy in the study of developmental psychology is the importance of the effect of heredity and/or experience, more commonly debated in terms of nature versus nurture. Piaget (1972) addressed this issue in the following discourse:

> The development of the cognitive functions, like any other, does, in fact, presuppose an increasingly close collaboration between the factors of environment and genes, the former increasing in importance the larger the subject grows . . . maturation as regards cognitive functions simply determines the "range" of possibilities at a specific stage. It does not cause the actualization of the structures. Maturation simply indicates whether or not the construction of specific structures is possible at a specific age. It does not itself contain a preformed structure, but simply opens up possibilities--the new reality still has to be constructed (p. 123).

Wadsworth (1978) commented that the preceding view also suggests that development and related learning can be affected by education and other forms of experience; the potential effects of these are more evident in the advanced developmental stages of the child.

Piagetian Constructs

Adaptation

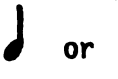
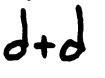
Central to Piaget's (1969) cognitive theoretical foundation is the idea of adaptation (adaption), which he viewed in the biological sense:

> Continuous assimilation of things to activity proper and the accommodation of those assimilative schemata to things themselves. . . . All intelligence is an adaptive process (p. 158).

Piaget further stated that adaptation always requires activity, usually the manipulation of objects on the part of the child. Furthermore, intrinsic motivation must accompany all new learning situations with spontaneity if optimal learning is to be realized.

Wadsworth (1978) believed that the most efficient use of adaptive learning results when instruction is matched to the child's developmental level, thus avoiding premature concept mastery until the learner has exhibited the specific prerequisite capabilities.

Operations and Structures

In his discussion of logical thought, Piaget (1970) emphasized the role of "operations" and "structures." He stated that actions are isolated events that lead to the development of operations, and operations, in turn, lead to the realization of structures. Operations are mental acts and have four main characteristics: (a) they are internalized actions, which means they can be carried out in thought as well as action; for example, a child can think about playing a violin even though it is not visually present; (b) they are reversible--addition and subtraction are the same operation carried out in opposite directions; (c) they always maintain some invariant although a transformation or change always occurs; for example, in the process of addition, pairs of notes can be grouped in different ways ( or ), but the sum remains invariant; and (d) no single operation exists alone, but is always related to a structure or network of operations; for example, the

addition-subtraction operation is related to the operations or classification and order.

Operations, in turn, facilitate the development of structures, or "schemata," the highest order mental operations. Certain laws apply to all parts of a structure according to Piaget (1970):

> The system of whole numbers is an example of a structure, since there are laws that apply to the series as such. Many different mathematical structures can be discovered in the series of whole numbers. One, for instance, is the additive group. The rules of associativity, communitivity, transivity, and closure for addition are all held within the series of whole numbers (pp. 22-23).

Simply stated, Lefrancois (1982) defined schemata as the intellectual component of reflexive behavior, and since they are behaviors he offers the examples of "looking schema," "reaching schema," etc., for clarification. Although structures (schemata) are the highest-order mental organizations, Piaget (1970) built on this idea by stating that structures are substructures of structures, and that many structures are substructures of larger ones.

Assimilation and Accommodation

According to Piaget and Inhelder (1969) and Furth (1969), the constructs of assimilation and accommodation, occurring in tandem, are also central to Piagetian theory. Assimilation refers to the relation of a stimulus to a reacting organism, or an organism-inward direction. It is the incorporating process of an operative action, a taking in of environmental data, not in the casual mechanistic sense, but as a function of an internal structure that by its own

nature seeks activity through assimilation of potential material from the environment.

Assimilation is not passive, but is an active pursuit of knowledge by an organism. An example in the area of music would be the child who has just been taught how to hold a violin and actively seeks the knowledge of bow management.

- Assimilation is a prerequisite for accommodation, the outgoing process of an operative structure to a particular situation and always contains some element of newness. Accommodation actively transforms the organism according to the particular characteristics of the input. Assimilation and accommodation both result in new behavior patterns, or what Piaget again refers to as "schemata." Regarding the child who desires the knowledge to correctly hold a violin bow, when this information is accommodated, it disturbs the child's previous structure of "knowledge about the violin" and creates an improved schemata that includes all previous violin information in addition to the newly acquired bow management facts.

Equilibrium and Equilibration

Two final constructs, equilibrium and equlibration, illustrate the role of intrinsic motivation in Piagetian theory. Piaget and Inhelder (1969) stated that equilibrium can be thought of as a temporary state of balance, a stability between the processes of assimilation and accommodation in the child's cognitive system. Both must occur for optimal development. Wadsworth (1978) further clarified the issue by stating that equilibrium functions as a

"self-regulating" factor in the development of the child's knowledge with accommodation modifying, but not eliminating, the old structures.

Piaget (1971) clarified the meaning of equilibration in his discussion of equilibrium:

> When I speak of equilibrium, it is not at all in the sense of a definitive state that cognitive functioning would be able to attain. Attained equilibrium is limited and restrained, and there is a tendency to go beyond it to a better equilibrium . . . so, simply stated, there is a continual search for a better equilibrium. In other words, equilibration is the search for a better equilibrium in the sense of an extended field, in the sense of a growth in coherence (p. 18).

A cyclic example of the aforementioned constructs of assimilation, accommodation, equilibrium, and equilibration in the discipline of music would be the following scenario. Student A has a reasonable knowledge of major scales and performs them with accuracy on his violin. He is not at this time actively seeking knowledge of new or different scales. Student B is heard by Student A performing a minor scale on his violin. This intrigues Student A and he actively pursues the knowledge needed to play a minor scale on his instrument. This temporary upsetting of Student A's equilibrium with regard to scales renders him in a state of equilibration. Assimilation occurs as Student A seeks out the knowledge needed to perform the scale. The information is accommodated as Student A modifies his existing schemata of scales to file the new minor scale content. The old schemata is not discarded, but implemented or expanded and Student A is once again in a state of equilibrium.

Méthode Clinique

Inhelder (1962) stated that it was through the interview technique, entitled méthode clinique, that Piaget analyzed his observations in the following manner: (a) he qualified by classification the different types of reasoning, (b) he analyzed his data according to existing logical models, (c) he analyzed frequency of responses according to age, and (d) he constructed a hierarchy employing ordinal scales.

Piagetian Stage Theory

The ensuing discussion reflects a synthesis of four publications: (a) The Origin of Intelligence in Children by Piaget (1952), (b) Logic and Psychology by Piaget (1957), (c) The Psychology of the Child by Piaget and Inhelder (1969), and (d) "Some Aspects of Piaget's Approach to Cognition" by Inhelder (1962). Piaget elaborated his cognitive developmental theory in terms of four invariant, sequential, age-related stages. The criteria, as stated by Inhelder, includes the following:

1. Each stage involves a period of genesis and a period of attainment. Attainment is characterized by the progressive organization of a composite structure of mental operations.
2. Each structure constitutes at the same time the attainment of one stage and the developing of the next.
3. The order of succession of the stages is constant. Ages of attainment can vary with certain limits as

a function of factors of motivation, exercise, cultural milieu and so forth.

4. The transition from an earlier to a later stage follows a law of implication analogous to the process of integration, proceding structures becoming a part of later structures.

Sensorimotor Stage 0-2 Years

This stage is characterized by development from a state of reflex activity to an organized sensorimotor action system which permits increasing mastery of objects in the environment. It is a type of prelanguage intelligence where perception and motoric actions are prominent. An infant who progresses from groping the floor with his hand to groping a drum, and finally seeking, internalizing, and obtaining the drum which is hidden under a box, would constitute a sensorimotor hierarchy. When the object can be said to have attained a permanent character in the child's mind and when it is recognized as continuing to exist beyond the limits of the perceptual field, the child has achieved the transition to the preoperational stage.

The Carabo-Cone (1977) approach to music learning, which deals exclusively with highly structured sensorimotor techniques and is personally endorsed by Piaget, illustrates a practical application of some of his principles. Focused toward preschool and elementary-aged children, the interactive pedagogic program is based on the child's ability to deal with abstract musical knowledge by means of visual, tactile, auditory, and kinesthetic experiences reminiscent of

the first days of life. By focusing on one musical concept with the entire body, and entering into play activities that appeal to a child's egocentrism, the Carabo-Cone approach has been successful with the learning-disabled, as well as with the normal student population.

Preoperational Stage 2-7 Years

The preoperational stage is a transitional period from the predominantly autistic and egocentric preoccupation of early childhood to the forms of social behavior, sociocentric speech, and conceptual thought of the elementary school-aged child. The child must learn to adapt to the thought of others and to conceptualize his own experiences on a higher level of development.

The semiotic function, also known as representational or symbolic activity, is the primary achievement of the preoperational period. Piaget's insight regarding the unifying symbolic character of such activities as imagination, play, imitation, and language have contributed to his theory of operative intelligence.

Primarily perceptually oriented, the preoperational child makes judgments in terms of how things appear, and can generally deal with only one variable at a time. Inductive reasoning (particular facts to general conclusions) and deductive reasoning (general to specific facts) are not possible. The stage can be divided into two substages: the pre-conceptual, 2-4 years; and the intuitive stage, 4-7 years. At the former level, the child operates on the principle of transduction; thought is tied more to the perceptual aspects of individual

situations and the child is unable to form concepts. A child who attends a concert and later mimics the cellist playing the instrument is exhibiting a gestural preoperational activity. If the child uses the word "cello" to communicate what he has heard, then he is exhibiting a linguistic preoperational representation.

Concrete Operations 7-11 Years

The stage of concrete operations represents the resolution of the conflict between logic and perception through the construction of operative structures. Children who have mastered this stage can deal with logical classification, seriation, numbers, spacial and temporal coordination, and causality.

Reversibility of thought, or conservation, is the hallmark in the continuum of transition from preoperational to concrete operational thought. Children able to conserve utilize decentration, rather than centration and can follow successive changes through various types of detours and reversals while cognitively maintaining the invariant factor. The operations are tied exclusively to actions, so they are concrete as opposed to abstract. The eight "groupements" of the concrete operational stage enumerated in Modgil and Modgil (1976) are:

i. hierarchical classification
ii. seriation of order of succession
iii. substitution of equivilence
iv. symmetry
v. multiplication of classes
vi. multiplication of series
vii. one-to-many equivileance in classes
viii. one-to-many equivilence in series (pp. 42-43).

A musical example of early concrete operational behavior reflecting groupement one would be the following task. In an attempt to ascertain if a child can classify objects in more than one way, the child is given 10 pictures of instruments--the first five of the same object (trumpet) with each picture a different color. The second five pictures are all different instruments and colors. A final assortment of pictures contains one which is the intersect of the first and the second five.

The task just described involves a child's choosing the single picture from the last group that relates appropriately to both groups. This task is usually attained by age 6-7. An aural musical analogue would be hearing three different lengths of notes all of the same timbre and three more notes of the same length, but with different timbres. Three more stimulus sounds would be presented where the child would have to determine the intersect of the first three and second three sounds.

Reflecting the ability to conserve, part of groupement viii, an aural musical task would be to listen to a short melody; a second melody would be the same, but with a slight change in rhythm. A child who is able to conserve will not only be able to express that the second melody is both the same and different, but state exactly why, and what has been altered.

Formal Operations or Propositional Thinking 11-15 Years

During the formal operational stage, the quintessence of Piagetian cognitive theory, the child becomes capable of applying

abstract, logical thought to all classes of problems. There are two substages, ages 11-12 and 14-15.

Functionally, formal operational thought and concrete thought are the same in that they both employ logical operations. The major difference between the two types of thought is the much larger range of application of logical operations available to one who possesses formal operational thought.

At the formal operational level of thought, one can eliminate a variable not only to control its effect, but also to find the effects of changes in a second variable without changes in itself. With the asset of formal operational thought, a variable can be separated by neutralization, as well as by exclusion. A variable can be eliminated not only to establish its own influence, but as a means of studying the influence of other variables.

The deductive reasoning at the formal operational level is no longer in reference to perceived reality, but to hypothetical statements and to propositions, the postulation of facts or events independent of whether or not they actually occur. The child becomes increasingly capable of reasoning not only on the basis of objects, but also on the basis of hypotheses. "Hypothetico-deductive" reasoning, or hypothesis formulation and testing, is evidenced both linguistically and through logical construction. A new group of operations, or "operational schemata," is now available. The first deals with the combinatorial operations of combinations, permutations, and aggregations. Gruber and Vonèche (1977) stated that the remaining relate to: (a) proportions, (b) probabilities, (c) correlations,

(d) coordination of two systems of reference, relativity of motion, and/or accelerations; (e) multiplicative compensations; and (f) the forms of conservation which go beyond direct empirical verification.

Another type of reasoning integral to formal operational thought, but not exemplified by all tasks requiring abstract thought, is one of a mathematical nature involving the four transformations: (a) identity, (b) negation, (c) reciprocity, and (d) correlation. They can be better understood through the following musical examples created by this researcher:

1. The first, "I," is identity. A palindromic melody would qualify as an example of identity as either side from the middle is unchanged.

2. The second, "N," is negation or inverse. If a phrase has been extended by the addition of two extra measures, then the subtraction of two measures would subsequently yield a shorter phrase.

3. The third, "R," is reciprocal or compensation. If two measures were added to the right hand piano part, then the addition of two measures to the left hand would be a reciprocal act.

4. The fourth, "C," is correlate. A melody which exhibits 50% of its rhythm patterns as being regular and 50% as syncopated can be made more regular sounding by reducing the number of syncopated patterns by 25% or increasing the number of regular patterns by 25%.

The INRC group, according to Piaget and Inhelder (1969), represents the five transformations that mark the passage from the concrete

operational level of thought to the stage of formal operations. The five, in order of progression, are: (a) hypothetico-deductive reasoning; (b) propositional logic; (c) dissociation of form from content, or the ability to replace any concrete proposition by an arbitrary sign (formal logic); (d) the combinatorial system, the ability to derive subsets of propositions to arrive at all possible solutions to a problem; and (e) the system of all possible combinations.

Modgil and Modgil (1976) stated that with the development of formal operations, the child's fullest capacity for problem solving is present, but continued acquisition of new contents and elaboration of previous learnings continues to occur. It is also important to note that although this final stage of cognitive development is attained, one does not always choose to employ his logical capacities in all situations due to fatigue or boredom.

Piagetian Research in Music

Conservation Research

Gruber and Vonèche (1977) stated that in his writings, Piaget's only reference to music was in relation to the necessity of possessing an "inner mathematics." Interpretations since the 1960s, through descriptive and experimental music research, have espoused the ideas of conservation and selected aspects of formal operational thought. In an effort to identify the existence of age-related musical abilities paralleling those delineated by Piaget, the focal points have been the music listener behaviors of percept and concept.

To further clarify the role of Piagetian theory in music research, Bower (1979) purported that Piaget's infralogical operations are more useful in analyzing the arts since they apply to relationships between parts entailing spatial or temporal independence as an entity. Infralogical operations develop roughly at the same time as logical operations, more commonly known as concrete operations. Logical operations concern themselves with discontinuity of individual objects, whereas infralogical operations reflect partition of a continuum. Number at the logical level corresponds to measure at the infralogical one. In a musical translation, infralogical thought would be represented by an understanding of meter signatures. At the logical level, a parallel would be an understanding of the individual notes and rests. Specific infralogical musical examples by Bower include the determination of the characteristics or origins of phrases or themes given certain information concerning their lateral or linear relationships, and the analysis of similarities determining parallelism and/or derivations of given phrases or themes.

Since Zimmerman's (née Pflederer) 1964 pilot study, a plethora of prototypical and replicative projects have been reported with results indicating either what is conserved at a specific age level or the effects of training. These studies include: (a) Zimmerman and Sechrest (1968), (b) King (1972), (c) Thorn (1973), (d) Botvin (1974), (e) Foley (1975), (f) Bettinson (1976), (g) Perney (1976), (h) Serafine (1977), (i) Ashbaugh (1980), and (j) Zimmerman and Webster (1983). Serafine's (1980) synoptic and critical review of

musical interpretations of Piagetian constructs offers the reader insight regarding a number of the aforementioned studies in addition to some provocative material for debate. Her major criticisms center around the lack of aural cognition tasks without the contamination of visual and verbal factors, in addition to the lack of validation procedures.

Conservation was singled out by Zimmerman (1964) for its applicability to developmental music learning, and as a guiding premise she reasoned that "a child's musical learning is inseparable from other learnings and follows the same general patterns of development" (p. 251).

Current endeavors in conservation research have expanded to include such unique and diverse applications as: (a) the relationship between auditory and visual perception on tasks employing Piaget's construct of conservation (Rider, 1977), (b) the relationship between field dependence-independence and children's responses to musical conservation tasks (Matson, 1979), (c) the effect on the musical achievement and performance of beginning band students exposed to method books reflecting Piaget's theory of conservation (Kress, 1981), (d) the formulation of a Piagetian aesthetics (Turgeon, 1981), (e) the teaching of the mentally impaired based on Piagetian constructs (Strockbine, 1982), and (f) a validation study of rhythmic conservation in Suzuki violin students (Nelson, 1984).

Formal Operational Research

The disciplines of mathematics and science are replete with formal operational research as Piaget's original tasks were formulated in these areas. To this researcher's knowledge, only two investigations in music, Larsen (1973) and Cutietta (1982), specifically and tangentially address aspects of formal operational thought.

Larsen investigated the transition from concrete to formal operations in a four-step interview procedure with 24 subjects: 8 third, fifth, and seventh graders. His focus on problem-solving abilities was through systematic permutation of a given melodic pattern. Permutations are mentioned by Piaget in conjunction with formal operations and the combinatorial logic aspect of problem solving, usually attained toward the middle of the 12-15 year age period. The researcher theorized that the melodic permutations of inversion, retrograde, and retrograde-inversion were types of variation that required the use of formal operational mental structures for their recognition.

Larsen concluded that: (a) there was a significant difference in the amount of time required by subjects at the third, fifth, and seventh grade levels to complete the ordering of a set of pitches to match a given model with older subjects completing the task faster than the younger ones; (b) there was a significant difference in the number of repetitions of a model presented by the testor, with older subjects requiring fewer repetitions; (c) there were some difference in the amount of time required by subjects at each grade level to

complete the ordering of a set of pitches to match the contour of a given model, with older subjects completing the task faster; (d) there was a difference between the number of subjects at each grade level that accepted the principles of inversion, retrograde, and retrograde-inversion as a valid means of varying the original melodic pattern with only seventh graders accepting these permutations as valid; and (e) there was a difference in the type of rationale used by subjects accepting the permutations as a valid means of varying the original melodic pattern and those subjects rejecting these principles as valid.

This researcher would like to argue the case for formal operational inferences in the Larsen study on the basis of the existence of hypothesis formation and testing. The criterion of hypothesis-testing and verification was evident in this study, but judgments required of the subjects were tied totally to concrete objects (instruments and graphic representations). An investigative problem-solving situation did not exist.

An important contributing factor in the success of the older subjects on the tasks was their math experience, particularly with geometric relationships, which would have been much more extensive than that of the younger subjects. The visual representations of the original melodic contour, when compared with the permutations, would be a nonmusical measure of conservation as the subjects were asked whether the permutations were a valid means of achieving melodic variation without regard to the sound. This appears to be a nonmusical measure of conservation; more accurately, it would qualify as

conservation of substance. Although only seventh grade subjects could conceptualize the relationship between the original contour and the permutations, it is interpreted by this researcher as being due to the more sophisticated conservational abilities of the 12-year-old child and not necessarily an endowment of formal operational ability.

Cutietta (1982), in an effort to analyze musical focus and hypothesis-testing techniques in 330 subjects between the ages of 11 and 16, conducted three group tests, 8 items each, of existing literature 20-30 seconds in length. The task was to determine which element each selection had in common with six out of eight "positive exemplars," each selection clearly exhibiting a particular musical concept. Cutietta concluded that between the ages of 11-16, learners appear to increase their ability to use a hypothesis-testing technique for musical concept formation. Using the scanning theory of Bruner, the author stated that systematic scanning is more evident in subjects after age 13. Due to highly significant relationships between hypothesis-testing, age, gender, and tonal memory, Cutietta also concluded that hypothesis-testing is more a function of maturation than amount of music education. Cutietta's final conclusion, in light of Piaget's theory, was that the ability to manipulate more than one hypothesis at a time was congruent with his formal operational theory.

In conclusion, Beard (1969) offered the reflective remark that the emphasis Piaget gives to verbal communication is too great. She

wished to see the exploration of other methods of representation in advancing formal operations as a means to aid pupils in translating from one form of representation to another. Although the verbal component cannot be totally removed from formal operational behavior, the aforementioned studies have offered a hybrid approach to the challenge of musical interpretations.

The Role of the Microcomputer in Music Education

Peters' (1984) stated that Computer-Based Music Instruction (CBMI), an application of Computer-Based Education (CBE) to music, had its genesis in Computer-Assisted Instruction (CAI) of the 1960s. For the music profession, specifically music education in a classroom setting, Franklin (1983) reported that the microcomputer offers a delivery system with the following benefits: (a) individualized instruction, (b) student level adjusting, (c) immediate positive reinforcement, (d) elevated motivation, (e) consistency, (f) organized instruction, and (g) personalized instruction.

Loading heavily in the cognitive and psychomotor domains, Williams (1983) stated that CBMI for the student provided teaching strategies for (a) drill and practice, (b) laboratory simulation, and (c) tutorial assistance. Upitis (1983) reported that among the unlimited applications of CMBI are the following: (a) ear-training such as interval and chord drill; melodic, harmonic, and rhythmic dictation; (b) key signatures, scales, and notational drills; (c) composition; (d) analysis; (e) music history; (f) instrumental fingering and techniques; and (g) event simulation.

Contributing as an aid to teaching music, Franklin (1983) stated that Computer-Managed Instruction (CMI) offers the instructor of music a medium through which to: (a) store records, (b) prepare progress reports, (c) predict future coursework, and (d) generate tests.

Arenson and Hofstetter (1983) stated that two of the most comprehensive systems working in tandem for CBMI are the Graded Units for Interactive Dictation Operations (GUIDO) developed at the University of Delaware, and programmed Logic for Automatic Teaching Operations (PLATO) located at the University of Illinois. Together they offer complete programming in ear training and theory using graphics, touch input, and a fully programmable sound synthesizer.

Placek (1985, 1986) presented some of the practical music software currently available. The variety of programs include: (a) keyboard fingerings, (b) trumpet fingerings, (c) rhythmic reading and creation, (d) practical music theory, (e) basic musicianship, and (f) intonation drills.

Upitis (1983) cited one of the most recent trends in CAI is its use as a means for allowing users to actively manipulate variables and develop strategies for problem solving. Bardige (1983) remarked that advances in software include not only problem-solving activities, but the learning problems associated with them. He cited another positive aspect of current software as its ability to allow students to use the computer's memory to monitor their own learning and to chart approaches and intermediate solutions they apply in solving problems.

Learning Style Relevance in Knowledge Acquisition

Investigation of learning style (cognitive or conceptual style) has rapidly expanded into a state of the science due to the belief that accommodating differences does improve achievement. Fizzell (1984) stated that reevaluation and clarification of universally recognized "individual differences" poses a challenge to which educators must respond in some way through their specific content areas.

Simply stated by Cawley, Miller, and Milligan (1963), a learning style is a learner's preferred way of doing things that relates to the acquisition of knowledge. An alternative explanation by Kagan, Moss, and Sigel (1963) is "the ways in which an individual selects, organizes, and processes the educative experiences in the perceptual organization and conceptual categorization of the external environment" (p. 74).

Fizzell (1984) outlined three types of approaches that are recognized in the broad theoretical framework of learning style research: (a) global personality perspectives, (b) cognitive mapping, and (c) school-oriented approaches. The school-oriented approaches are synonymous with the moniker "learning styles" and allow for more flexibility in interpretation in a generic sense.

Hill (1972) explained the current nature of learning styles in educational science as differing from those defined and described in the field of psychology:

> The construct of cognitive style is a vehicle which can be used to diagnose individuals and prescribe activities that provide the high probability of the student's accomplishing successfully the educational task confronting him. It should

> be noted that the cognitive style of an individual is a relative concept, and depends not only upon the educational level and cultural background of the individual but upon the symbolic condition of the task to be considered. Under these circumstances, the construct of cognitive style provides a means of analyzing, interpreting, and evaluating educational endeavors in a manner relatively different from those usually employed (p. 15).

Although in no way exhaustive, the Music Listener Learning Style Inventory constructed for this investigation assisted in drawing conclusions about selected preferences for specific styles of listening strategies. The preference statements in the Inventory were intended to be generalized only to the research tasks in this study, and cannot be assumed as a reliable measure in other aural assessments at this time.

Conclusion

Some additional information, lending the necessary closure to the import of formal operational reasoning, is offered by Arlin (1976), Day (1981), and Kämii (1984).

Arlin stated that implications of recent research are that a fifth stage, a problem-finding stage, is hypothesized in addition to the problem-solving level espoused by Piaget. She further stated that problem solving is not the final equilibrium, although it is stable and remains available throughout life.

Day arrived at the conclusion that formal operational skills are important for functioning in a complex, democratic society. She stated that the skills are essential for selecting a political candidate, determining the best car to purchase, or attempting to evaluate alternative explanations of current social events.

In a recent statement on the uniqueness of Piagetian theory in education, Kämii purported that the ability to think logically is synonymous with autonomy, and it is autonomy that should be the aim of education in our schools today. She further expounded that Piaget's tenets, if used as the basis for curriculum development, counteract the ubiquitous underdeveloping of potential, and conformist emphasis in education today. Kämii recommended an educational "revolution" that would shift the current focus to the developmental nature of children and allow for more problem solving in the pursuit of intellectual autonomy. Piaget (1974) mentioned autonomy as his general aim for education. His global vision was to generate individuals who could think independently, create new knowledge, revise social organizations, and acquire moral values.

CHAPTER III

PROCEDURE

Introduction

The present investigation evolved into a seven-phase procedure that included: (a) development of the Melodic Strategram computer program; (b) construction of a Student Protocol; (c) construction of the Music Listener Learning Style Inventory; (d) subject selection; (e) the pilot test; (f) administration of the final assessment; and (g) tabulation, analysis, and interpretation of the results.

Development of the Melodic Strategram

As a result of its user-friendliness, fairly accurate pitch reproduction, and availability, the Atari 800XL microcomputer was chosen for task administration. Atari Basic was the language employed. Another important consideration in the selection of a microcomputer for task administration was the standardization of both test directions and the musical portion of the task. Four musical phrases, to serve as the task melodies, were written by this researcher. For this particular study, it was not imperative to control all of the musical variables in the composition of the phrases as the strategies of the subjects and not the musical answers, per se, were the primary, independent variables. The following conditions prevailed in phrase composition: (a) all four melodies were four measures in length, or

a musical phrase; (b) melody 1--major mode, duple meter, MM=88; (c) melody 2--major mode, duple compound meter, MM=69; (d) melody 3--minor mode, duple meter, MM=88; and (e) melody 4--minor mode, duple compound meter, MM=76.

For each of the four task melodies, seven variations were written to function, in addition to the original task melodies, as concrete information in the experiment. The seven variations were: (a) rhythm; (b) mode; (c) tempo; (d) rhythm and tempo; (e) mode and rhythm; (f) mode and tempo; and (g) rhythm, mode, and tempo. An eighth choice was an exact repetition of the original stimulus. The four original melodies were validated for their adherence to the specified criteria by three music theory graduate students in the School of Music at Michigan State University.

All four melodies were realized on the computer with like timbres and consisted of a representative combination of conjunct and disjunct melodic motion, regular and irregular rhythms. The four original task melodies can be found in Appendix D.

The computer program, consisting of Part I, Instructions, and Part II, the Melodic Strategram, was completed within a six-month time span. The total RAM (random access memory) required for the program was 19K. Both parts were self-paced, each student proceeding as slowly or as quickly as suited his style. The computer program can be referred to in its entirety in Appendix E.

Construction of the Student Protocol

The Student Protocol was designed to incorporate criteria categories gleaned from other established Piagetian assessments. Three levels of formal operational thought were assessed. Also included was a section for task answers and a strategies entry line displaying the order in which each subject listened to the task melodies and variations. Supplemental information gathered from the interview (self-report of how a student proceeded) was recorded under the comments section of the Protocol. (Refer to Appendix F.)

Music Listener Learning Style Inventory Construction

Based upon beliefs deemed important to this investigation, the Inventory was constructed in a Likert Scale fashion. A continuum of five choices measured preferences ranging from strongly disagree (1) to strongly agree (5). (Refer to Appendix G.)

The Inventory presented 13 beliefs that directly reflected the listener's learning style in terms of completion of the Melodic Strategram. The information was designed to reflect Piagetian implications, for example, predetermined strategies and verbalization of the musical variables. Other Inventory statements dealt with information that was helpful in determining the exact manner in which a subject proceeded in completing the tasks.

Subject Selection

During the Winter Term of 1985, permission was sought from the University Committee on Research Involving Human Subjects at Michigan

State University. A total of 80 subjects, 40 currently enrolled music and nonmusic major students was requested. A cover letter and a procedure outline was forwarded to the committee. (Refer to Appendix H.)

In order to obtain a pool of subjects from which to solicit subjects, four Michigan State University School of Music instructors were approached for their cooperation. Two instructors of undergraduate music theory and two music fundamentals for nonmusic majors (Music 135) instructors consented to allot class time for this researcher to present a synopsis of the study and to compile a list of volunteer names and phone numbers. An appointment, not in excess of one hour, was then made at this researcher's office in the School of Music, a quiet, sterile environment where the computer equipment was temporarily housed.

The Pilot Test

In March, 1985, a pilot test was conducted with five music major and five nonmusic major students. The subjects were volunteers. The nonmusic majors were students in this researcher's Music 135 class and the music majors were students in the School of Music. Both the Student Protocol and Music Listener Learning Style Inventory were pilot tested and results of the test were carefully analyzed in terms of inherent task or interview problems which might contribute to the overall program fluency. The pilot test results can be found in Appendix I.

The Final Assessment

During the Spring Term of 1985, a total of 72 subjects was tested, each subject scheduled for a one-hour appointment at his/her convenience. No coersion or remuneration existed for the participants in the study. This researcher felt that the opportunity and challenge offered the students through the computer program would be an adequate incentive for participation. During the interview hour, liquid refreshment was made available to the subjects.

The actual interview commenced with a few minutes of acquaintance conversation and an overview of the project. When the subject was reasonably comfortable, the computer was readied and the subject was given verbal instructions to familiarize himself/herself with the computer keyboard. With the location and understanding of the 10 keys necessary for the program execution, the subject enacted the program and read through the directions on the computer screen in a leisurely manner. The test administrator at this time labeled the forms and waited until the subject was ready (approximately 90 seconds).

During the next phase of the interview, prior to the actual listening segment, the subject was asked questions regarding the Protocol information. For example, each task was prefaced by the statement, "How do you think you are going to proceed?" If a subject was silent after completing each task, the task administrator probed further until a statement was made. If a meaning was unclear, neutral probing continued to convey the need for more detail. Each subject was asked to verify his/her procedure at the close of each task. At

the end of the fourth and last task, the subject was asked to comment verbally on the value of the Melodic Strategram as an ear-training instrument. The last event of the interview consisted of the Inventory completion.

Final Phase

All of the information from the completed protocols and inventories was tabulated, analyzed, and interpreted according to the problem and subproblem statements. The Statistical Package for the Social Sciences (1975) subprogram for Analysis of Variance was used to determine the effects of the Inventory preferences on the formal operational scores.

CHAPTER IV

RESULTS OF STUDENT ASSESSMENTS

Introduction

Chapter IV is presented in the following sequence: (a) the interview, (b) protocol scoring, (c) strategy measurement, (d) inventory scoring, (e) pilot test results, and (f) final assessment results.

The Interview

The intent of this study was to gather empirical strategic and preference data through a structured interview rather than a pencil and paper assessment. The clinical interview progressed in the following sequence:

1. A brief, casual converation with each subject.
2. Familiarization with the Atari microcomputer equipment.
3. Written instructions presented on the computer screen.
4. Answers to questions regarding execution of the program.
5. Reminder by task administrator that the melody to be determined should sound least like the original melody.
6. Time check by administrator at the start of each task.
7. Question by administrator: "Do you have any idea how you are going to proceed in identifying the correct melody?"

8. Subject freely verbalizes what he hears, and the procedure (if any) that is followed.
9. Note taking by administrator regarding pertinent verbal comments. For example, musical descriptors, strategies, or psychomotor involvement.
10. At the end of each task, the administrator asked the subject to explain his answer. If the subject refrained from verbal commenting during the task, questions regarding the strategies were asked.
11. The subjects were asked if they developed a strategy while completing the task.
12. A brief respite (one minute) was allotted between tasks to allow for form completion by the administrator. The interview was recorded on a tape cassette machine for further detailed analysis.
13. After completion of the four tasks, each subject was requested to answer all of the questions on the Music Listener Learning Style Inventory.
14. Upon termination of the Melodic Strategram, each subject was given the correct answers to the tasks and any additional information regarding this researcher's conception of the Strategram.
15. The subjects were thanked for their participation in the study and a list of the persons interested in the investigation results was made.

Protocol Scoring

Demographic data was entered on the protocol by the task administrator at the outset of the interview. For each of the three levels of formal operational thought, four spaces were allotted for each category in order to record responses to the four tasks. When the subject verbally reflected a statement, a check was made in the appropriate section. The final score was calculated by adding up the number of checks in each level of thought category. The category receiving the most checks represented the formal operational score of the subject. In the case of a tie, the task administrator reevaluated the information and redistributed a check in the appropriate category. In the strategy section, the administrator entered the first twelve numbers of the listening sequence from Task IV onto the protocol form. One of the goals of the Melodic Strategram was to allow each subject the freedom to develop a strategy for listening. Since the results from the pilot inventory verified the fact that a strategy was developed during the progression of the tasks, the fourth task strategy was accepted as indicative of the subject's workable plan. Another important consideration of the decision was the need to limit data for statistical analysis.

Strategy Measurement

Two anticipated, sequential listening strategies clearly emerged as the tasks were evaluated. Strategy 1 reflected the consistent, periodic repetition of the original melody with new musical information introduced through the foils. This constant reference back to

the original melody, rather than the introduction of new information contiguously, is an example of centration.

Emerging as the second strategy was the repeated listening to the original melody prior to proceeding with the foils. This strategy was most closely represented by the sequence 000012345 etc. It is referred to as a decentration process, where a subject memorizes (internalizes) the musical information in the original melody and makes comparisons among the new information provided in the foils. Decentration is an acquisition of the concrete operational stage of development and is unequivocally necessary for formal operational reasoning.

Inventory Scoring

The inventory information was manually tabulated on a master code sheet. All of the statements from the inventory were subjected to two-way classification analysis of variance (ANOVA). The purpose of this statistical analysis was to determine if there were any significant differences between the two independent variables of performance score and major on the dependent variable of each preference statement in the inventory. The existence of interactions, the combined effects of the independent variables upon the dependent variable, was also determined by ANOVA.

Pilot Test Results

The pilot test conducted in this study was necessary in order to determine the following: (a) the endurance level of the subjects in

terms of aural concentration, (b) the subjects' reaction to the aural computer stimulus, (c) the environmental setting for the assessment, (d) the efficacy of the clinical method of assessment, and (e) the kinds of strategies chosen by music and nonmusic major subjects.

1. The length for administration of the assessment did not exceed 60 minutes. Aural fatigue was reported by one student only, a nonmusic major.

2. The test directions proved clear and the low-stimulus environment provided an adequate setting for the assessment.

3. Student response to the administrator's probing questions was considered maximal. The test administrator's probing first occurred while the student was actually listening to the melodic examples. This proved to be rather distracting to the subjects in terms of concentration. Probing was limited to the beginning and end of each task with subject self-report insights reported during the task at the discretion of the subject.

4. The protocol was deemed adequate for data gathering and was adopted for the final assessment.

5. The inventory used for the pilot test was comprised of nine statements. Question #7 was discarded, and statements #2 and #5 were reworded.

6. Expansion of the inventory was deemed necessary and the following statements were added: (a) #3--making decisions quickly on what I am hearing in music works better for me than taking time for reflection; (b) #8--I prefer listening to a melody at regular

intervals during a listening task as opposed to numerous hearings at the outset of the task; (c) #13--I feel that the Melodic Strategram would be an effective ear-training program; (d) #10--verbalizing (talking) about what I am hearing in music helps me to focus more in depth on what is happening; and (e) #11--verbalizing (writing) about what I am hearing in music helps me to focus more in depth on what is happening.

7. The pilot test did not require the identification of age, time-on-tasks, or sex by the subjects. Two categories for the aforementioned were added to the final protocol.

The statistical results of the pilot test are presented in Figure 1. In Figure 1a it was observed that 80% of both groups received a formal operational score of two. This would seem quite plausible for the nonmusic major, but a greater number of music major students would have seemed more likely in category three, absolute formal operational thought.

Regarding centration and decentration, again, the results do not seem unusual for nonmusic majors. The fact that all music majors used centration was a curious phenomenon that needed further explanation with a larger sample.

The number of correct task answers indicated an absence of skewed items, and the four melodies and variations were incorporated into the Melodic Strategram for the final assessment.

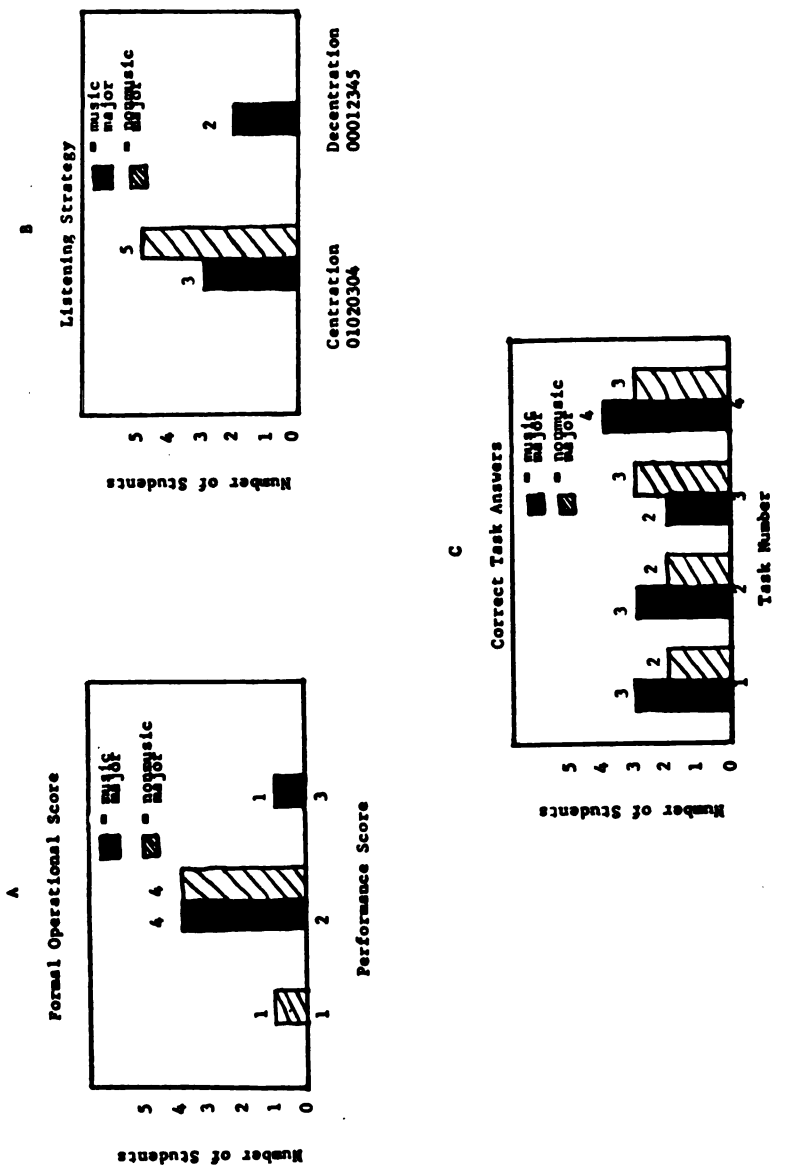


Figure 1. Statistical Results of Pilot Test.

Final Assessment Results

Four measurements constituted the results of the final assessment: (a) a formal operational score, (b) a centration/decentration listening strategy, (c) a correct task answer, and (d) an agree/disagree continuum of music listener preferences. A summation and tabulation of the total number of music and nonmusic major scores on the first three areas are reflected in Figure 2. As anticipated by this researcher, a greater percentage of music majors were able to adopt a formal operational approach to the Melodic Strategram. It was also predicted that in the content area of music, the low-experienced nonmusic major would not be fully capable of the verbal aspect of formal operational reasoning.

Figure 2 of correct task answers shows a curious phenomenon. Task #2 was the most difficult of the four tasks for the music majors, but the converse was true for the nonmusic major students. The Task #2 melody was written in duple compound meter, major mode, and MM = 88. The answer to the task was a change to the minor mode, a rhythm change to straight eight notes, and a tempo change 10 metronomic beats faster. This researcher cannot render an explanation why this would be so. This finding would be worth further investigation in a study geared toward musical conservation specifically.

The overall performance of the music majors on the task answers indicates an approximate 70% success rate. Except for the deviation on Task #2, the performance was consistent. Since the four musical tasks took at least 45 minutes to complete collectively, it was

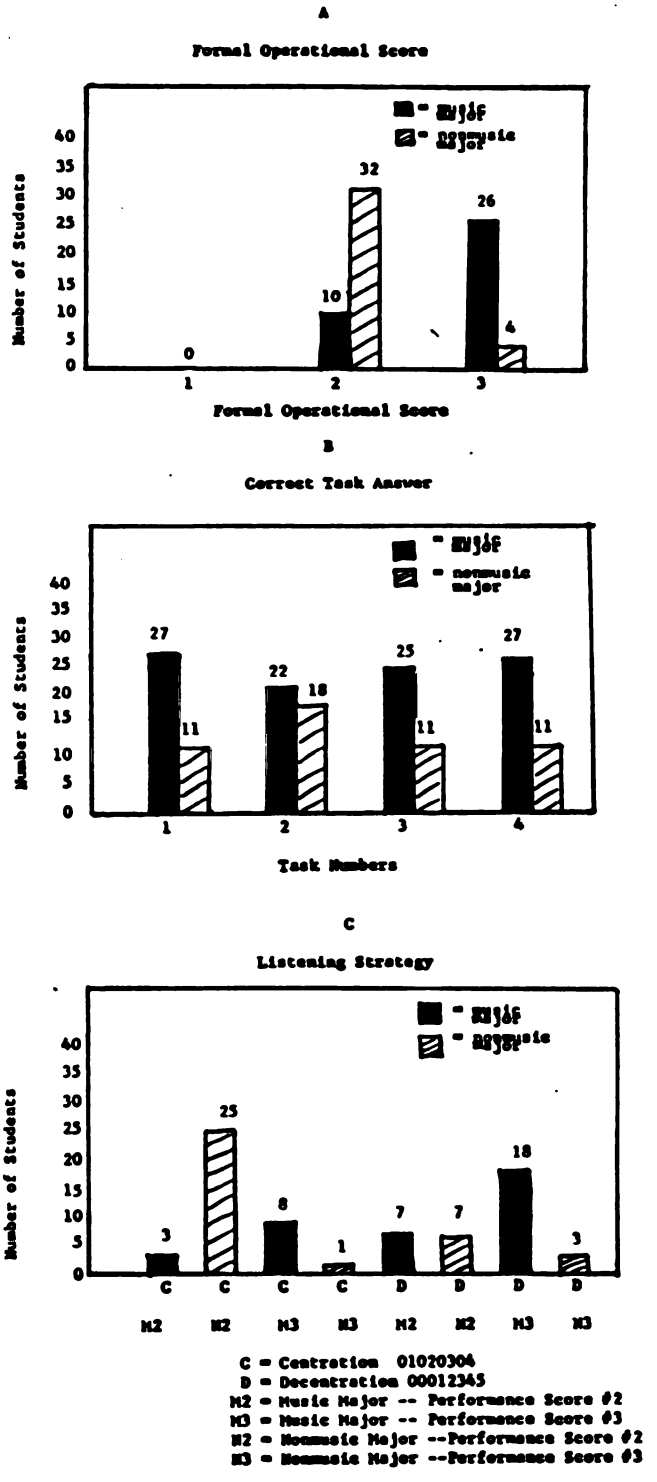


Figure 2. Final Assessment Results of Formal Operational Score, Correct Task Answer, and Listening Strategy.

predicted that an increase in the number of correct answers would be a logical outcome. This was thought to be so as a residual increase in perceptual acuity. A possible explanation for this behavior might lie in the inherent difficulty or order of the musical examples.

Aside from the sizeable increase of correct answers in Task #2, the nonmusic major subjects were extremely consistent in the number of tasks answered correctly. Again, what this researcher hoped to observe was an increase in the number of correct answers as the students progressed through the Melodic Strategram. The rationale behind this outcome was the opportunity for each subject to develop efficient and workable strategies for music listening.

Figure 2c, dealing with the centration/decentration aspects of Piagetian theory, yielded less than desirable results. Approximately 70% of the nonmusic majors functioned with a centrational orientation. Of the music major students, 50% succeeded with decentration. This second percentage is viewed as a conservative number by this researcher. It seemed as though at least 80% of the music majors would be capable of a decentrational approach. A possible explanation for this might be in the Melodic Strategram itself or in the population sample. Perhaps the sample of students could have performed better on the tasks if they had chosen a decentrational approach. If the subjects were incapable of such reasoning, a pre-formal operational acquisition, problems could surface in more sophisticated musical analysis. If a centration-oriented listener was required to analyze thoroughly, an

unfamiliar musical composition, a discussion of its variables would exceed the three employed in this assessment.

Further detailed tabulation of the formal operational performance scores, centration/decentration strategies, and task answers, have been provided in Figure 3. With decentration as the formal operational goal, the results indicate that Task #4 had three nonmusic scoring 3-D. This was an increase of one person over the previous three tasks. This could have been due to chance, or perhaps could have been an effect of training since the increase was on the final task.

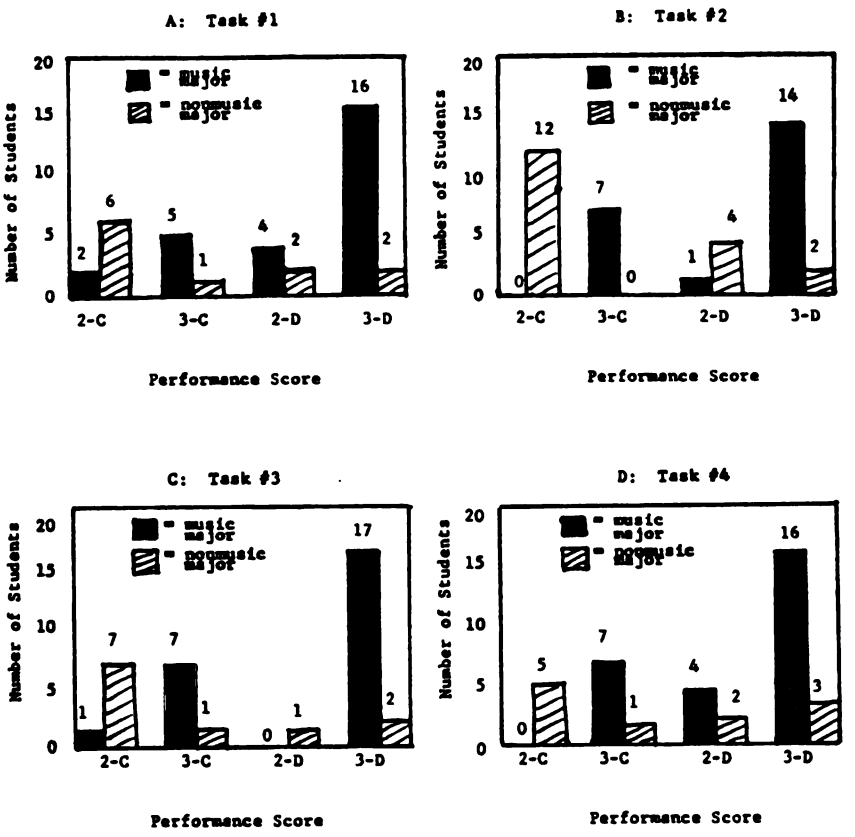
The music majors scored fairly equally on 3-D. Reflecting the greatest number of 3-D's was Task #3. The lowest number of 3-D's was evidenced in Task #2. Task #2 was also the task that was answered correctly the least.

Surveying the 3-C scores, the next acceptable formal operational strategy, it is observed that the music majors increased in number. The nonmusic major 3-C's remained constant, except for Task #2, where no 3-C's were reported.

The 2-C's for the music majors basically diminished to zero while the 2-C's for the nonmusic majors peaked on Task #2 with 12, and decreased to 5 in Task #4.

Analysis of Variance

A two-way classification analysis of variance (ANOVA) was conducted in order to determine if differences in response to the inventory statements occurred. The independent variables were:



2-C = Performance Score #2 - centration
3-C = Performance Score #3 - centration
2-D = Performance Score #2 - decentration
3-D = Performance Score #3 - decentration

Figure 3.--Final Assessment Results Stratified by Task.

(a) performance score (2--intermediate formal operational thought, and 3--absolute formal operational thought); (b) major (music, nonmusic); and (c) the combined effects of performance score and major upon each inventory statement. The inventory statements are presented below in the following format: (a) the inventory statement, (b) the statement rationale, (c) the null hypothesis, and (d) the statistical results in both tabular and graphic formats. The tabular statistics are located in Appendix I.

The null hypotheses under consideration were:

H1: There will be no difference between the two performance scores on the mean response to each inventory statement.

H2: There will be no difference between the music and nonmusic majors on the mean response to each inventory statement.

H3: There will be no interaction between performance score and student major on the mean response to each inventory statement.

The accepted level of confidence for this study was .05. The necessary F value, with one degree of freedom for the numerator mean square and 68 degrees of freedom for the denominator mean square was 3.98. In other words, any F values in the following report which were lower than 3.98 necessitated acceptance of the null hypotheses under consideration. When the F value was equal to, or in excess of, 3.98, the null hypotheses were rejected.

Statement 1

#1: I prefer an unlimited amount of time to complete music listening tasks.

Rationale: Inventory Statement #1 was incorporated into this investigation as a reflection of Piaget's emphasis on unlimited interaction time between subjects and stimuli as crucial in cognitive development.

Statistical results: Consulting the table of F, it was found that the results of the F test for H1 ($F = 0.256$), H2 ($F = 0.099$), and H3 ($F = 0.783$) all indicate an absence of significance. All of the null hypotheses were, therefore, accepted. As the formal operational score increased from 2 to 3 for the nonmusic major, a marked agree preference for unlimited time also occurred.

Figure 4 shows the mean scores of each major group, music and nonmusic, further stratified by performance score.

Statement #2

#2: I found it easy to complete the four listening tasks (easy to concentrate and didn't have to repeat many melodies).

Rationale: Inventory Statement #2 was incorporated into this investigation to assess the overall difficulty of the program.

Statistical results: The results of the F test for H1 ($F = 1.344$), and H3 ($F = 1.422$), both indicate an absence of significance. The

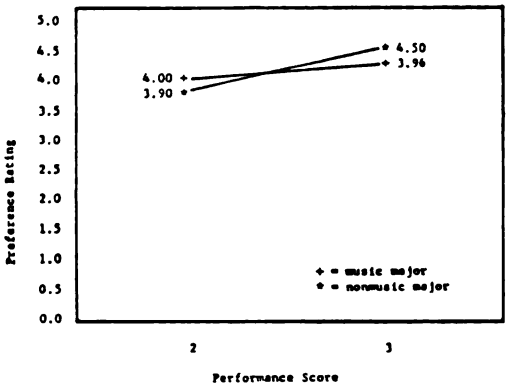


Figure 4. ANOVA Results for Inventory Statement #1.

F test for H2 (F = 5.999) indicates significance and the null hypothesis was rejected. While the difference between the nonmusic major 2's and 3's was minimal, the 3's were finding it harder to complete the tasks. A plausible answer might be that the nonmusic majors did in fact have to concentrate harder and repeat more of the melodies while engaged in deductive reasoning. The music majors who scored a 3 found it easier to complete the tasks. This researcher feels this result is due to the more adept aural functioning, listening strategy efficiency, and variable manipulation ability of the music major. Figure 5 shows the mean scores of each major, music and nonmusic, further stratified by performance score.

Statement #3

#3: Making decisions quickly on what I am hearing in music works better for me than taking time for reflection.

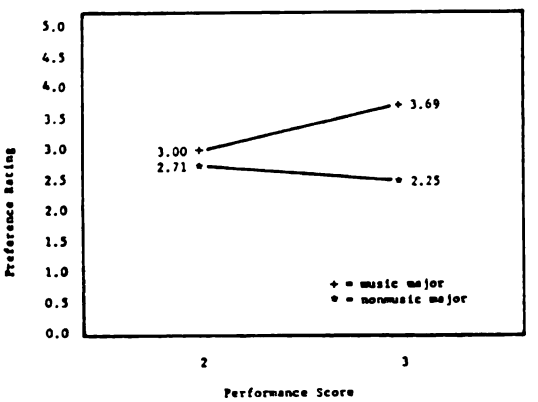


Figure 5. ANOVA Results for Inventory Statement #2.

Rationale: Piaget stated that the ability to make decisions is an important aspect of formal operational thought. This research was designed to assess the decision-making differences of music and nonmusic majors.

Statistical results: The results of the F test for H1 ($F = 0.144$), H2 ($F = 0.355$), and H3 ($F = 0.064$) all indicate an absence of significance. All of the null hypotheses were, therefore, accepted. While music majors unanimously agreed that they were undecided on this statement, the nonmusic majors were better decision makers as they improved in their formal operational scores.

Figure 6 shows the mean scores of each major, music and nonmusic, further stratified by performance scores.

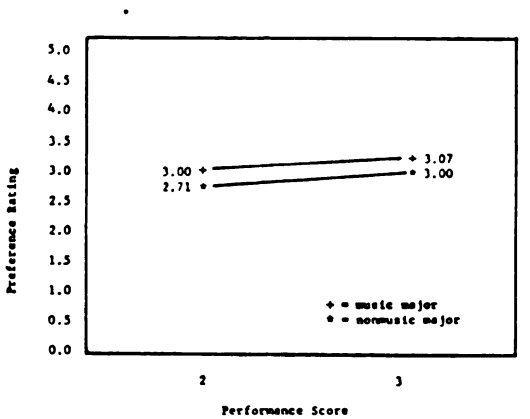


Figure 6. ANOVA Results for Inventory Statement #3.

Statement #4

#4: I had a predetermined plan or strategy as I began the first task.

Rationale: The person who is capable of formal operational thought will have a strategy or plan of attack when working on a problem involving variable manipulation.

Statistical results: The results of the F test for H1 ($F = 0.685$), H2 ($F = 0.036$), and H3 ($F = 0.001$) all indicate an absence of significance. All three null hypotheses were accepted. The results to Statement #4 are baffling. Both music and nonmusic majors showed a decrease in predetermined strategies as their formal operational scores improved.

Figure 7 shows the mean scores of each major, music and nonmusic, further stratified by performance scores.

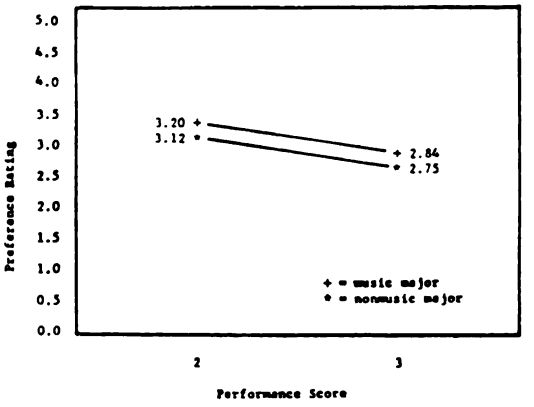


Figure 7. ANOVA Results for Inventory Statement #4.

Statement #5

#5: I developed a strategy for music listening that helped me as I continued completing the tasks.

Rationale: If a subject were in the process of developing a more formal operational approach to problem solving, the Melodic Strategram offers the opportunity for such development.

Statistical results: The results of the F test for H1 ($F = 3.663$), He ($F = 0.360$), and H3 ($F = 0.413$) indicate an absence of significance. All three null hypotheses were accepted. Although not significant, H1 merits discussion. Cursory observation of Figure 8 reveals that strategies for music listening were developed as formal operational scores improved. This is an exciting finding as this researcher would like to employ the Melodic Strategram as a training instrument in future music instruction.

Figure 8 shows the mean scores of each major, music and nonmusic, further stratified by performance score.

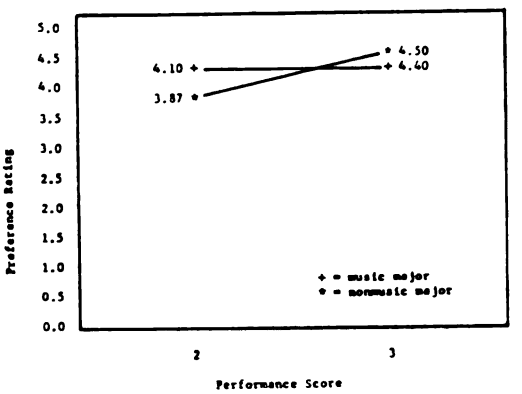


Figure 8. ANOVA Results for Inventory Statement #5.

Statement #6

#6: I can aurally distinguish melodies that are changed in more than one way very easily.

Rationale: This statement deals directly with the difficulty of perception and manipulation of musical variables in the Melodic Strategram.

Statistical results: The results of the F test for H1 (F = 2.03) and H3 (F = 0.308) indicate an absence of significance. The F for H2 (F = 13.70) is significant. It is confirmed with the rejection of H2 that both music and nonmusic majors agree that they were able

to distinguish simultaneous variations easily as their formal operational scores improved.

Figure 9 shows the mean scores of each major, music and nonmusic, further stratified by performance scores.

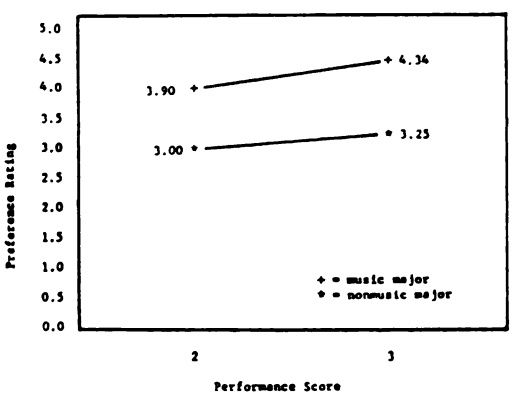


Figure 9. ANOVA Results for Inventory Statement #6.

Statement #7

#7: I prefer listening to a melody a number of times before making comparisons to other melodies.

Rationale: This statement was asked in order to solicit information on the centration/decentration process reflected in the Melodic Strategram.

Statistical results: The results of the F test for H1 ($F = 0.731$), H2 ($F = 0.098$), and H3 ($F = 0.000$) all indicated an absence of significance. All of the null hypotheses were rejected. Since 3.1 was the

highest preference rating for this statement, it appears that both music and nonmusic majors mildly disagree. This seems to imply a centration process where the original melody is referred to at regular intervals. This information is slightly incongruent with the decentration strategy exhibited by the 3-D music majors.

Figure 10 shows the mean scores of each major, music and nonmusic, further stratified by performance scores.

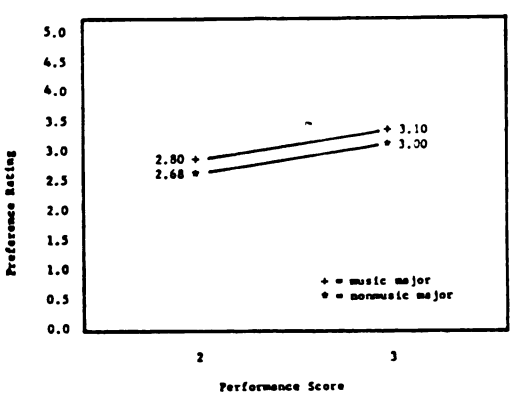


Figure 10. ANOVA Results for Inventory Statement #7.

Statement #8

#8: I prefer to listen to a melody at regular intervals during a listening task as opposed to numerous hearings at the outset of the task.

Rationale.--This statement was asked in order to solicit information on the centration/decentration process reflected in the Melodic Strategram.

Statistical results.--The results of the F test for H1 ($F = 0.160$), H2 ($F = 2.778$), and H3 ($F = 0.614$) all indicate an absence of significance. The three null hypotheses were rejected. The preference rating of the music majors in inventory statement #8 decreased considerably as the formal operational score improved. This result is congruent with the music majors' predominant decentration strategy.

Figure 11 shows the mean scores of each major, music and nonmusic, further stratified by performance scores.

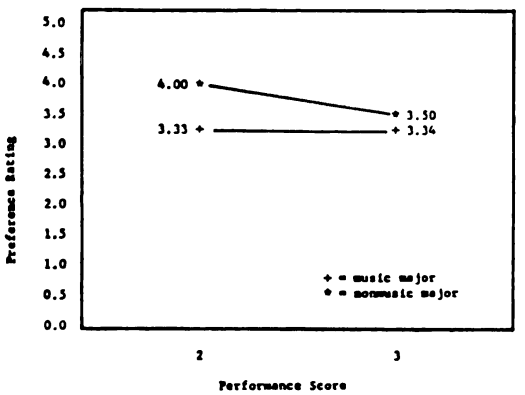


Figure 11. ANOVA Results for Inventory Statement #8.

Statement #9

#9: The number of times (repetition) I listened to a melody is an indication of some aural difficulty for me.

Rationale.--This statement was incorporated into the inventory to solicit information on aural difficulty in general.

Statistical results.--The results of the F test for H1 (F = 1.342), H2 (F = 1.019), and H3 (F = 0.726) all indicate an absence of significance. All three null hypotheses were accepted. On this statement, the nonmusic majors strongly agreed that repetition of the melodies was not an indication of aural difficulty as their formal operational scores improved.

Figure 12 shows the mean scores of each major, music and nonmusic, further stratified by performance scores.

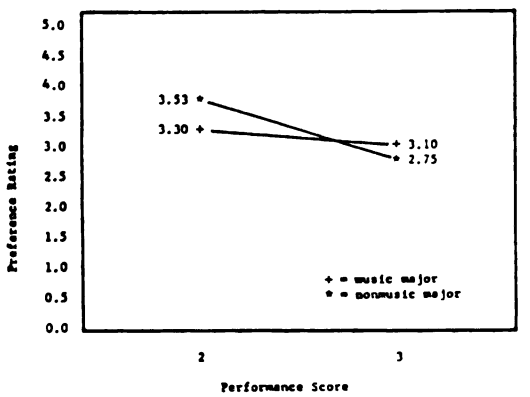


Figure 12. ANOVA Results for Inventory Statement #9.

Statement #10

#10: Verbalizing (talking) about what I am hearing in music helps me to focus more in depth on what is happening.

Rationale.--This statement reflects Piaget's verbal criterion as a function of formal operational thought and also his general emphasis on the social transmission of ideas.

Statistical results.--The results of the F test for H1 (F = 0.019), H2 (F = 0.729), and H3 (F = 2.206) indicate an absence of significance. All three null hypotheses were accepted. Talking about what one is learning in music was preferred more by music majors who scored three. The high scoring nonmusic major disagreed that verbalizing was helpful in focused musical analysis.

Figure 13 shows the mean scores of each major, music and nonmusic, further stratified by performance scores.

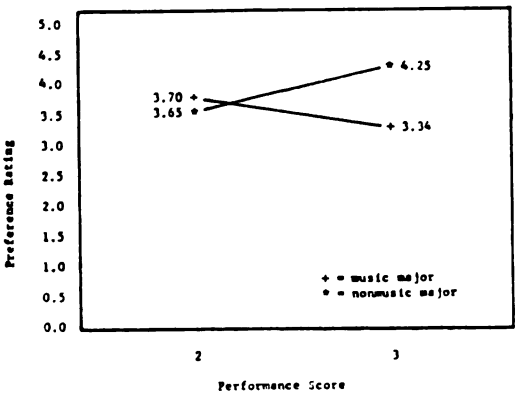


Figure 13. ANOVA Results for Inventory Statement #10.

Statement #11

#11: Verbalizing (writing) about what I am hearing in music helps me to focus more in depth on what is happening.

Rationale.--Same rationale as #10.

Statistical results.--The results of the F test for H1 (F = 0.315) and H3 (F = 1.079) were not significant. H2 (F = 6.228) was significant. Nonmusic majors are in agreement that writing about what they are hearing is not helpful in improving formal operational scores. Perhaps this is due to the inadequate verbal capabilities of the nonmusic major in the content area of music. It might also suggest a need for verbal imagery as words may be confusing the issue.

Music majors, on the other hand, concur that writing about what they are hearing is very helpful. This finding is verified by the laborious notes taken by music majors while completing the Melodic Strategram.

Figure 14 shows the mean scores of each major, music and nonmusic, further stratified by performance scores.

Statement #12

#12: I prefer to listen to music performed on orchestral instruments rather than realized on a computer.

Rationale.--Viewing the Melodic Strategram in terms of a training instrument for aural music variable analysis, this researcher

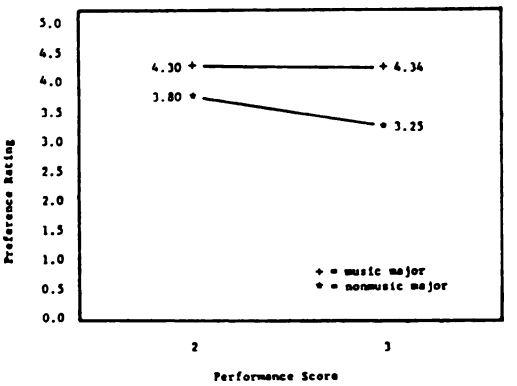


Figure 14. ANOVA Results for Inventory Statement #11.

felt the need to determine the effect of computerized sound on the listener.

Statistical results.--The results of the F test on H1 (F = 2.245) and H2 (F = 3.579) were not significant. H3 (F = 5.395) yielded an interaction. The obvious conclusion of this finding is that the experienced music major does strongly prefer orchestral instruments for aural musical exercises. The nonmusic majors, quite unexpectedly, chose to favor computer-realized music as their score improved.

Figure 15 shows the mean scores of each major, music and non-music, further stratified by performance scores.

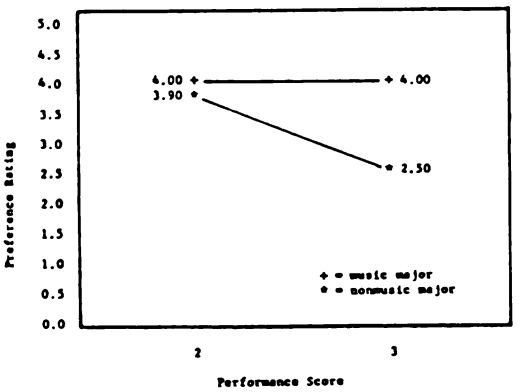


Figure 15. ANOVA Results for Inventory Statement #12.

Statement #13

#13: I feel that the Melodic Strategram would be an effective ear-training program.

Rationale.--One of the potential functions for the Melodic Strategram would be that of an ear-training instrument. Its purpose would be twofold, that of fostering aural perception and conception, and that of assisting the listener in the development of strategies for focused musical analysis.

Statistical results.--The results of the F test for H1 ($F = 0.921$), H2 ($F = 0.817$), and H3 ($F = 0.920$) all indicate an absence of significance. The null hypotheses were all accepted. Both the music and nonmusic major scores converged from an extremely positive preference rating to a lesser degree of agreement. It is heartening to observe

that both the music and nonmusic majors viewed the Strategram as effective, but somewhat perplexing why the preference rating declined as the formal operational score improved.

Figure 16 shows the mean scores of each major, music and non-music, further stratified by performance scores.

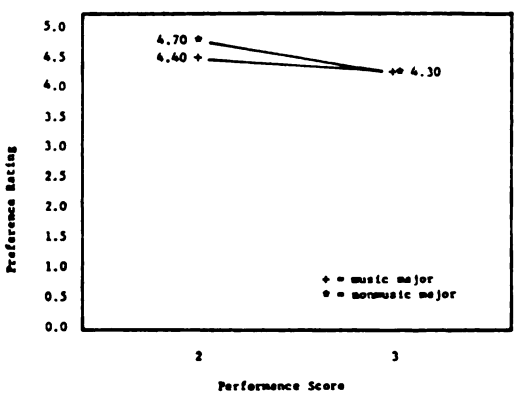


Figure 16. ANOVA Results for Inventory Statement #13.

CHAPTER V

SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

Summary

Deductive reasoning, reflected most frequently in the emphasis on discovery learning, has been deemed a powerful and thorough facilitator of cognitive development. In our increasingly complex, high-tech society, we are required to exhibit refined analytical and strategic abilities in order to sort out, and process, huge amounts of information.

Piaget, in a discussion of his formal operational level of cognitive development, has stressed the need for educators to promote hypothetico-deductive reasoning in their specific content areas. This recommendation is a direct result of current research in Piagetian theory indicating that the deductive nature of hypothesis testing is deficient in a high percentage of persons chronologically, but not cognitively, capable of this higher level of reasoning.

Factors, such as the amount of information, memory, and the specific content area being addressed, have been purported by Kimball (1976) to directly affect hypothesis-testing abilities. Another critical factor stated by Kimball is the void of formal operational activities in course curricula outside the areas of science and mathematics. Formal operational activities, reflecting the analysis

of a process as well as a product, are notorious for their time consumption and are often ignored by instructors. Furthermore, introducing such activities in any content area during the concrete operational stage of development would assist in an individual's transit to a more analytical mode of reasoning. Increasing the use of formal operational activities during the stage proper would assist in maintenance of the ability and/or an improvement in the scope or depth of the ability.

In the content area of music, this researcher chose aural musical analysis as the focus of deductive reasoning ability. Musical memory was controlled in this study by the permission of unrestricted listening, and the amount of information to be processed was manageable, albeit challenging.

The problem of the present investigation was fourfold: (a) the creation of a computer-programmed aural musical analysis activity employing hypothesis testing, (b) the measurement of university music and nonmusic major subjects' attainment on selected formal operational criteria, (c) the analysis of centrational/decentrational listening patterns, and (d) the analysis of selected learning style preferences as they related to the completion of the Melodic Strategram.

Five phases evolved in the completion of this study: (a) the presentation of the need, and rationale, for formal operational reasoning in aural musical analysis; (b) the development of the Melodic Strategram; (c) the development of the data-gathering instrument; (d) the clinical student assessments; and (e) the analysis of the data.

Rationale for Formal Operational Reasoning

One of the foremost goals of this project was to present theoretical evidence for the existence of formal operational thought in both the conception and execution of the Melodic Strategram. Deductive reasoning was the mode of cognitive processing employed and the subjects' responses were categorized according to Piagetian criteria. An auxiliary goal of the project was the structuring of the Melodic Strategram so that prerequisite levels of Piagetian reasoning could be diagnosed. Although these levels were not formally assessed, they were obvious in the strategies chosen by the subjects.

Development of the Melodic Strategram

The most creative experience related to this researcher's project was the custom designing of the Melodic Strategram itself. At the time of the project's inception, a software package for melodic storage and retrieval for the Atari 800XL computer system was not extant. The components of each sound on the computer, for example, voice, pitch, and duration, necessitated individual programming. In addition, the tempo changes had to be superimposed on the melodies after the initial programming. At the outset of program construction, mistakes were numerous; both numerical miscalculations by this researcher and the dropping of bytes of the computer. Correction time was costly, but the program was perfected within a ten-month time span. An irritating difficulty was the computer's ignoring of the duration command in the fourth task. This resulted in some of the variations sounding in

diminution compared to their original programming or undergoing tempo changes in the middle of a melodic phrase. This phenomenon was due to the length of the program and was corrected easily by creating the program in two separate sections.

Pitch generation on the Atari 800XL was developed by this researcher to be less than average when compared to available home computers. This fact in no way interferred with the pilot test or final assessment as verbal complaints by the subjects regarding pitch accuracy or timbral annoyance were not registered.

Anecdotal student comments regarding the Melodic Strategram that occurred frequently included the following: (a) it is easy to operate and understand, (b) it is a creative approach to music listening that held my interest, and (c) the sequencing and self-pacing of the program helped me to concentrate on-task.

Development of the Data-Gathering Instruments

The Student Protocol functioned adequately as a framework for tabulating Piagetian formal operational criteria. While the protocol criteria reflected the deductive nature of the Melodic Strategram, other formal music tasks might require a more detailed or alternatively focused protocol. Although more than a modicum of time was necessary to score the protocols, it was justified by the valuable, detailed, subjective reasoning information elicited from each subject. Confusion, for example, between mode and contour, which was evident with the music majors and more so with the nonmusic majors, could have been

discovered only through self-report information as opposed to a group administered assessment.

The Likert scale employed in the Music Listener Learning Style Inventory gave the subjects an opportunity to register their preferences with some degree of specificity. While in no way exhaustive, the Inventory revealed important information regarding the learning preferences of music and nonmusic majors that should be considered in future instructional settings.

The Student Assessments

The assessment of formal operational abilities in any content area is a formidable task. While science, mathematics, and language educators have validated and disseminated an increasing number of measuring devices, clinical assessment has been aborted for the ease of group-test administration. For researchers who enjoy direct student interaction and the increased information gleaned through self-report clinical assessment, it is recommended that this approach not be abandoned.

The average completion time for the Melodic Strategram was 45 minutes, exclusive of the pauses between tasks. In terms of assessor involvement, the coding of information was time consuming and concentration was imperative.

Analysis of the Data

The Protocol used in this study employed three levels of formal operational reasoning and their relevant criteria. Level one was attained by one pilot test subject only. Post hoc grouping of all

other subjects resulted in levels of performance at two and three. Regarding the Protocol criteria, it is interesting to note the strengths of the subjects. Verbalization, as one would predict, was more prevalent among the music majors, whose discussion of the musical variables bordered on the elaborate. The subjects were able to discuss confusing factors after listening without constant referral back to the melodic stimulus.

A synopsis of the results is as follows:

1. Of the music majors, 72% received a formal operational score of three. The average of correct answers was approximately 61%. An average of 44% of the music majors who received a three rating employed a decentrational listening strategy.

2. Approximately 28% of the music majors received a formal operational score of two. The average of correct answers was approximately 8%. An average of 6% of the music majors who received a two rating employed a decentrational listening strategy.

3. Of the nonmusic majors, 11% received a formal oprational score of three. The average of correct answers was approximately 8%. An average of 6% of the nonmusic majors who received a three rating employed a decentrational listening strategy.

4. Approximately 89% of the nonmusic majors received a formal operational score of two. The average of correct answers was approximately 28%. An average of 6% of the nonmusic majors who received a two rating employed a decentrational listening strategy.

5. Nonmusic majors with a formal operational score of three found the tasks harder to complete than the nonmusic majors who scored two.

6. Strategies for music listening were developed by both music and nonmusic majors while completing the Melodic Strategram.

7. Music majors strongly agreed that they could aurally distinguish melodies that were changed in more than one way as their formal operational scores improved. Nonmusic majors were undecided.

8. Both music and nonmusic majors were basically undecided about whether they preferred to listen to a melody a number of times before making comparisons to other melodies.

9. The high scoring nonmusic major strongly agreed that verbalizing (talking) about what is happening in music was helpful in focused musical analysis.

10. While music majors strongly agreed that verbalizing (writing) about what they are hearing in music is helpful, the nonmusic majors were undecided.

11. Nonmusic majors showed a bias toward computer-originated music as their formal operational scores improved. Music majors preferred orchestral instruments across scores.

12. The music majors were undecided on whether making decisions quickly on what they were hearing in music worked better than taking time for reflection. More than a marginal gain in preference rating was evident in the nonmusic majors, who believed they became better decision makers as their performance score improved.

The melodies used in the Melodic Strategram were patterned after simple folk tunes or hymns and should not have presented any unusual problems. The fact that a reasonable number of music major students received a high formal operational score, but could not identify correct answers is perplexing. This inability suggests a perceptual and/or conceptual problem, which is a deficiency of an earlier cognitive growth period, namely, preoperations or concrete operations. Perhaps attending to three changes in a musical phrase is a challenge even for those with training. If this is so for a task with unrestricted listening, the implications for more complex aural analysis in a time-restricted parameter deserves attention. Another explanation for the less than expected results of the music majors could lie in the deductive nature of the Melodic Strategram. Identifying aurally the melody least like the original may have been difficult for students used to being told what to listen for in a musical example. It may be that with more experience in deductive listening strategies, both the music and nonmusic majors would show improvement.

Nonmusic majors as a group were quite confident that their answers were correct even when they were not. Graphics were used by most of the nonmusic majors in lieu of verbalization (written or oral). Both groups resorted to subvocalization, tapping, and conducting as they listened. The music majors tended to analyze in a micro-dimensional way as they listened. When probed further for their reasons, it was expressed that it was a residual effect from aural harmony study. This habit tended to disorientate some students. They

were listening for changes in the music that did not exist. When they finished listening to all of the melodies in the first task, it became clear that the changes were more obvious.

While mode was the first variant most frequently perceived by the music majors, it was the last for the nonmusic majors. For some unknown reason, the nonmusic majors frequently confused change of mode with a slowing down of the tempo and/or a change in the melodic contour. They were rarely able to conceptualize mode, even when probed further, their most frequent answers being a perceived change of pitches. This information could serve as the basis for future research in the perception and conception of melodic modes.

Music majors as a group had a much more difficult time with rhythm and tempo. In some instances tempo was perceived as augmentation and diminution. This was quite understandable, but it occurred in so few subjects that it was not a cause for concern.

Nonmusic majors had a habit of comparing what they heard to similar tunes or styles they knew. They verbalized this frequently and had all kinds of associative methods for retrieving musical information.

Recommendations

The following recommendations are offered to assist in further research related to the general goals and logistical execution of this project:

1. As a string major, this researcher was not toally pleased with the pitch accuracy of the Atari 800XL computer, and recommends

the use of an improved Atari machine or an alternative personal computer in order to obtain the highest degree of intonation.

2. The anomaly that music major students preferred computer-generated sound vis-a-vis orchestral timbres would prompt the development and usage of software for nonservice courses in music education and theory.

3. To maximize the ear-training potential of the Melodic Strategram, the following recommendations are offered: (a) the substitution of different musical variants, singly or in combination; (b) the programming of feedback; (c) the measuring of preoperational and concrete operational reasoning exclusively; and (d) the programming of musical examples that range from contrived phrases, simple folk tunes and hymns, to symphonic excerpts.

4. Recommendations for further assessment of learning preferences in aural musical analysis could include enlarging the pool of preferences or focusing on selected aspects of a particular style.

5. Concurrent with the tendency toward group testing is the "dynamic cognitive assessment" movement (Silverman, 1985), one that reflects the bias of this researcher. Extremely Piagetian in its conception, dynamic cognitive assessment promotes the idea that more insight into the learning process is gained when a person is evaluated in the act of learning. The movement goes one step beyond that of the traditional Piagetian stimulus-response-stimulus-response sequence by adding a teaching component. The paradigm now becomes test-teach-test. The advantage of dynamic cognitive assessment lies in the critical intervention of the test administrator at a point(s) of confusion.

Whereas Piagetian assessment uncovers and logs faulty reasoning for future reference, the assessor in a dynamic cognitive situation intervenes immediately to clarify the nature and focus of cognitive deficiencies. This researcher would like to see the model of the Melodic Strategram expanded in either of two ways. The first is to become a dynamic cognitive assessment device. Assuredly, this will be time consuming, but for diagnostic or remedial work in aural musical analysis both conservational (concrete operations) and formal operational aspects could be evaluated. Through the teaching components, the cognitive chasm leading to higher forms of reasoning could be bridged. The second, and probably most expedient use of the Melodic Strategram, would be to program direct feedback regarding the task answers. This would serve well as an adjunctive ear-training program to be used at the convenience of the student. For the instructor, the freedom would exist to combine and substitute musical variables. The positive responses of the nonmusic majors in particular warrant a closer look at the Melodic Strategram potential as a teaching device.

6. It was evident to this researcher that a number of music major subjects did not possess adequate perceptive and verbal abilities. These students were not identified by year in school, sex, or applied major in this study. Future researchers might well stratify such demographic information.

7. Decentrational listening, utilized by a majority of music and nonmusic majors scoring three on task completion and in identifying the correct asnwer, should be incorporated into aural musical

tasks. Studies determining the effectiveness of negative exemplars in music listening instruction are congruent with the function of decentration (Haack, 1972; Jetter & Wolff, 1985).

8. Verbalizing (writing) about what the music majors were hearing in music was helpful in task completion. It is recommended to encourage the nonmusic majors to write about what they were hearing, regardless of the level of technical sophistication.

9. This researcher advises that care be taken to preserve the deductive nature of the Melodic Strategram Program.

Conclusions

A fraction of the potential formal operational inferences for music education has been presented in this investigation. While deductive reasoning seems to be the cornerstone of Piaget's final cognitive developmental stage, other scientific formal operational tasks, some of which appear in Appendix A, are recommended for further analysis and interpretation regarding musical implications.

The intent of this study was to generate, in a heuristic manner, ideas concerning the interpretation of formal operational problem solving in music, and to further explore music listener behaviors. Although a composite definition of the formal operational music listener has yet to be formulated, this research study sought to illuminate the contribution of a blend of perceptual, linguistic, and logical abilities to such functioning.

An area not addressed in this study, but probably the most fertile, is that of creativity. The creative processes provide the opportunity

for: (a) decision making, (b) analysis, (c) evaluation and reevaluation, (d) interpretation, (e) problem solving, and (f) original thinking.

Other musical tasks that appear to lend themselves to formal operational interpretation include: (a) composition, (b) transposition, (c) four-part harmonic dictation, (d) metric modulation, (e) dodecaphony, and (f) complex style analysis, both aural and written.

Arlin (1976) states that problem solving is not the final cognitive equilibrium, although it is stable and remains available throughout life. She further hypothesizes the existence of a fifth stage, that of problem finding. This stage reflects a divergent, rather than convergent, cognitive emphasis.

The importance of providing formal operational activities for our students lies in the necessity to foster their development or to strengthen what already exists. As stated by Piaget, they do not, and cannot, occur on their own. It is not enough to determine if students can or cannot achieve specific musical goals. The identification of faulty reasoning, or conversely, fully developed cognitive processes, adds another dimension to our purpose. This dimension, to us as music educators, allows the addressing of individual differences so that all, not just the select, might achieve.

Tools and learning strategies must be provided for student interaction. The increased range of analytical reasoning that formal operations offer the student in any content area should be sufficient justification for time spent on the nurturing of their salutary effects.

APPENDICES

APPENDIX A

PIAGETIAN FORMAL OPERATIONAL TASKS

APPENDIX A

PIAGETIAN FORMAL OPERATIONAL TASKS

1. Verbal Problem (Piaget, 1968, p. 162).

   Edith is fairer than Susan; Edith is darker than Lily;
   who is the darkest of the three?

   This verbal problem involves one of internal serialization, inherently more difficult than the concrete serialization manifested in the concrete operational stage.

2. Hypothetic-deductive Reasoning (Wadsworth, 1978, p. 105)

   "Suppose coal is white . . ."

   Children who have attained formal operations can reason on the basis of assumption or can operate on the logic of an argument independently of its content. Concrete operational persons typically state that coal is black and deem the problem unsolvable.

3. Proportion (Piaget & Inhelder, 1958, pp. 164-166)

   After the age of 7 (concrete operations), children discover a small weight can balance a larger weight by placing it farther from the fulcrum than the larger weight. Children learn to equalize weight and length in a systematic manner, but they do not coordinate the two functions of weight and length as proportion. Around age 13, compensation of the proportion principle

(W/L = 2W/2L) occurs when the child becomes aware that an increase in weight on one side of the fulcrum can be compensated for by an increase in distance from the fulcrum on on the other side.

4. Combinatorial Logic (Piaget & Inhelder, 1969, p. 134)

Colorless Liquids

A child is presented with five jars, each containing a colorless liquid. The combination of three liquids (bottles 1,3,5) produces a yellow color. The other two bottles contain a bleaching agent or water. The child is shown the yellow liquid that can be produced, but he does not see how it is obtained. When children are asked to produce the yellow color, those of 7 to 11 years typically proceed by combining two liquids at a time. After combining pairs, the systematic nature of their searching stops. They may mix all five together (which do not produce a yellow color). After the age of 12, children typically test all possible combinations of one, two, and three liquids until the yellow solution is reached. The concrete operational child's explorations are systematic up to a point, but he does not explore all possible combinations.

APPENDIX B

PROBABILITY TABLE

APPENDIX B

PROBABILITY TABLE

comb no.	mode		rytha		tempo		*	Remarks
	major	minor	reg	irreg	fast	slow		
1	-	-	-	-	-	-	*	No variation in original melody (n=0)
2	X	-	-	-	-	-	*	One variation in original melody (n=1)
3	-	X	-	-	-	-	*	
4	-	-	X	-	-	-	*	
5	-	-	-	X	-	-	*	
6	-	-	-	-	X	-	*	
7	-	-	-	-	-	X	*	
8	X	X	-	-	-	-		Two variations in original melody (n=2)
9	X	-	X	-	-	-	*	
10	X	-	-	X	-	-	*	
11	X	-	-	-	X	-	*	
12	X	-	-	-	-	X	*	
13	-	X	X	-	-	-	*	
14	-	X	-	X	-	-	*	
15	-	X	-	-	X	-	*	
16	-	X	-	-	-	X	*	
17	-	-	X	X	-	-	*	
18	-	-	X	-	X	-	*	
19	-	-	X	-	-	X	*	
20	-	-	-	X	X	-	*	
21	-	-	-	X	-	X	*	
22	-	-	-	-	X	X	*	
23	X	X	X	-	-	-		Three variations in original melody (n=3)
24	X	X	-	X	-	-		
25	X	X	-	-	X	-		
26	X	X	-	-	-	X		
27	X	-	X	X	-	-		
28	X	-	X	-	X	-	*	
29	X	-	X	-	-	X	*	
30	X	-	-	X	X	-	*	
31	X	-	-	X	-	X	*	
32	X	-	-	-	X	X	*	
33	-	X	X	X	-	-		
34	-	X	X	-	X	-	*	
35	-	X	X	-	-	X	*	
36	-	X	-	X	X	-	*	
37	-	X	-	X	-	X	*	
38	-	X	-	-	X	X		
39	-	-	X	X	X	-		
40	-	-	X	X	-	X		
41	-	-	X	-	X	X		
42	-	-	-	X	X	X		
43	X	X	X	X	-	-		Four variations in original melody (n=4)
44	X	X	X	-	X	-		
45	X	X	X	-	-	X		
46	X	X	-	X	X	-		
47	X	X	-	X	-	X		
48	X	X	-	-	X	X		
49	X	-	X	X	X	-		
50	X	-	X	X	-	X		
51	X	-	X	-	X	X		
52	X	-	-	X	X	X		
53	-	X	X	X	X	-		
54	-	X	X	X	-	X		
55	-	X	X	-	X	X		
56	-	X	-	X	X	X		
57	-	-	X	X	X	X		
58	X	X	X	X	X	-		Five variations in original melody (n=5)
59	X	X	X	X	-	X		
60	X	X	X	-	X	X		
61	X	X	-	X	X	X		
62	X	-	X	X	X	X		
63	-	X	X	X	X	X		
64	X	X	X	X	X	X		Six variations in original melody (n=6)

NOTES: 1) X = Exist
2) - = Not exist
3) * = Reality for melodic strategram which has 27 combinations of variation
4) Number of possible combinations for any fixed number of variations in original melody is $\frac{m!}{n!(m-n)!}$ where m = all possible changes (not reality) (m=6: mode major, mode minor, rhytha reg., rhytha irreg., tempo fast, tempo slow)
n = number of variation changes per one combination

APPENDIX C

INDEX OF MELODIC STRATEGRAM PIAGETIAN TASK INFERENCES

APPENDIX C

INDEX OF MELODIC STRATEGRAM PIAGETIAN TASK INFERENCES

Index of Sensorimotor Inferences

Piagetian Criteria	Task Inferences
1. Psychomotor movement.	1. Body or individual parts move during the listening experience.

Index of Pre-operational Inferences

Piagetian Criteria	Task Inferences
1. Reliance on direct, overt action or manipulation of objects or events.	1. Subject is able to discuss task melodies only when actively listening to them. Thought is totally tied to action.
2. Emphasis on perception of objects or events.	2. Subject perceives aurally differences in the sound of each melody (rhythm, tonal, and tempi components) but cannot grasp the variation concept and is unable to verbalize said concept.
3. Emphasis on centration, the focusing on one particular attribute of an object or event.	3. Subject perceives only one musical element in a multi-element stimulus, for example, rhythm, and centers his discussion on that element alone.

4. Reliance on the construction of graphic images to reconstruct an object or event.	4. Subject utilizes paper and pencil to symbolize his perception of a melodic or rhythmic contour or sequence.
5. Propensity to focus on selected aspects of a relationship.	5. Subject is able to perceive aurally a relationship between two or more melodies that involve like rhythms but ignores totally tike tempi.
6. Acquisition of basic language and symbols for cognitive representation of experience.	6. Subject verbalizes musical elements such as "rhythm" with words like as "long," "short," "jumpy," "smooth," Pitch (tone) may be connoted by the words "high" or "low." Tempo may be represented by "faster" or "slower."
7. Evidence of transductive reasoning, or reasoning from particular to particular without touching on the general.	7. Subject refers to rhythm through use of nonmusical descriptions but does not generalize the concept of rhythm.
8. Evidence of syncretism, the general tendency to group together unrelated objects or events into a confused whole.	8. Subject relates two or more melodies by a commonality (rhythm, mode, or tempo) that in reality does not exist.
9. Evidence of juxtaposition, failure to perceive true relationships among several objects or events.	9. Subject fails to group melodies with like musical characteristics, for example, like tempi or mode.
10. Incipient concepts of classification, seriation, and conservation.	10. Subject is able, albeit inconsistently, to classify specific to general. For example, shorter notes perceived in one melody to overall rhythmic change. Classify: duration speed pitch

Seriate: Sequence certain musical elements: short-long, slow-fast, or conjunct-disjunct.

Conserve: Some reversibility of thought determining amount and effect of change a musical example undergoes.

Index of Concrete Operational Inferences

Piagetian Criteria	Task Inferences
1. Exhibits improved powers of mental imagery in which one successfully follows a series of manipulations or variations of objects or events or formulates new relationships.	1. Subject would be able to hold in his mind's ear an original musical stimulus while listening to a number of transformed stimuli (in this case melodies). Subject can more internally perceive a change and assess an absence or presence of complexity.
2. Ability to attend simultaneously to various facets of a relationship, both in discrimination and manipulation variables (decentration).	2. Subject is able to discuss verbally multiple changes in a musical stimulus, for example, double variations. This occurs when, for example, mode and tempo are aurally recognized and manipulated when compared and contrasted to the other melodies.
3. Ability to classify objects or events in more than one way--multiple classification.	3. Subject exhibits organized thought structures that permit the logical formation or categorization of musical variation, both single, double, and triple. The subject exhibits the ability to classify and reclassify melodies according to various musical characteristics. For example, task melodies that have a mode change are classified, then all that

	have a rhythm change. Not all mode-changed melodies will have a rhythm change, so reclassification is necessary. Categories are fluid as melodies are shifted around to consider the different elemental classifications.
4. Ability to seriate objects or events in a logical order.	4. Subject is able to seriate (sequence) musical concepts from simple to complex, for example, melodies with one, two, or three variations.
5. Ability to conserve or exhibit reversibility of thought.	5. Subject is able to follow cognitively alterations that are made in task melodies and to determine if the melody is essentially the same when compared to the original stimulus. (There are enough identifying characteristics to warrant qualitative similarity.)

Index of Task Formal Operational Inferences

Piagetian Criteria	Task Inferences
1. Thought directs observation. Subjects engage in reasoning activities on a purely verbal level.	1. Subject is able to organize his thinking prior to the actual listening. Subject is able to speak about his observations and choices as he proceeds in completing the task.
2. Hypothetico-deductive reasoning is evident, the ability to hold several variables constant while isolating and manipulating an additional variable in order to test a hypothesis.	2. Subject is able to monitor internally several musical variables while focusing on an additional one.

3. Systematic exploration of inter-relationships in an exhaustive manner.	3. Subject is able to ferret out the inter-relationships of the variations in a thorough manner. This is accomplished by setting up a system of categories and sub-categories that includes all variables.
4. Decrease in dependence on concrete objects.	4. Subject refers less to the actual aural melodies and relies on his internal images and memory.
5. Ability to differentiate all possible solutions to a problem versus the real.	5. Subject considers all of the variations possible in the melodies, but after adequate listening creates a pool of real or workable solutions.
6. Ability to replicate strategies through the use of systematic procedures.	6. Subject adopts a strategy that successfully assists him in identifying the melody least like the original and chooses to use it on another task.
7. Evidence of answer verification.	7. Subject re-listens to original melody at the completion of the task for a final comparison of his answer.

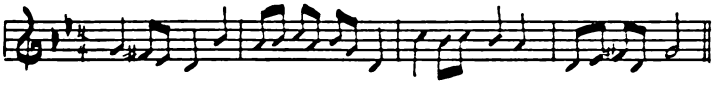
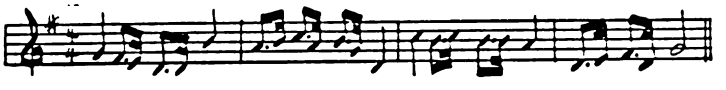
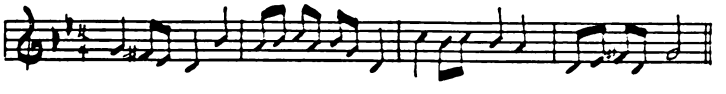
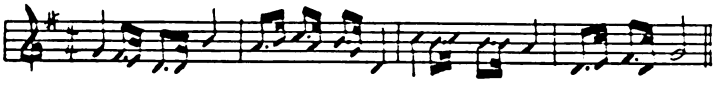
APPENDIX D

MELODIC STRATEGRAM TASK MELODIES

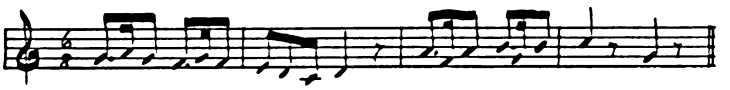
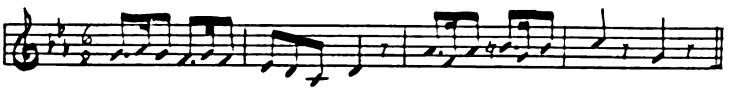
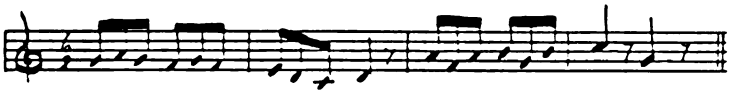
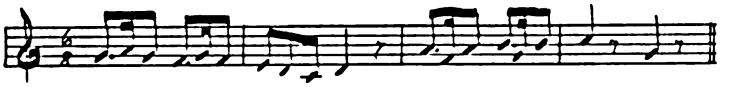
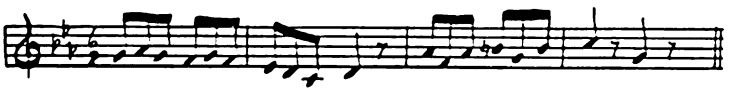
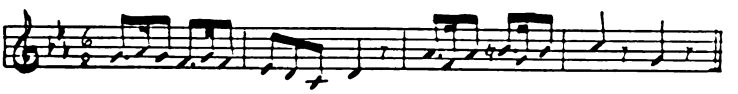
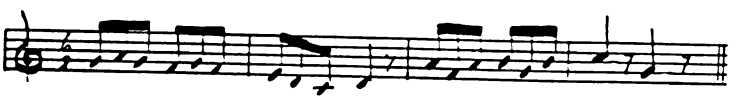
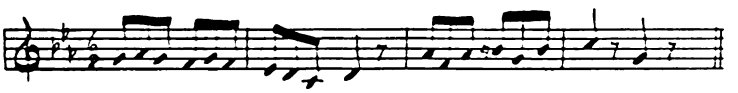
APPENDIX D

MELODIC STRATEGRAM TASK MELODIES

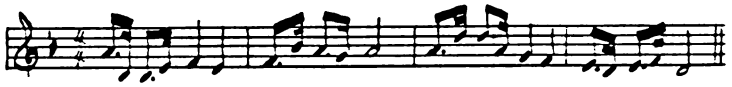
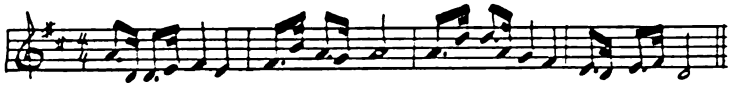
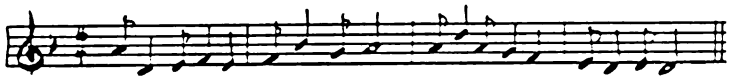
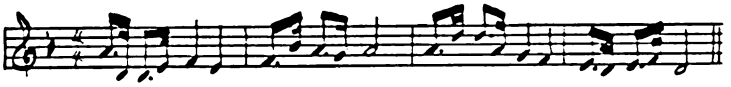
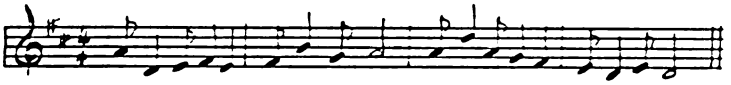
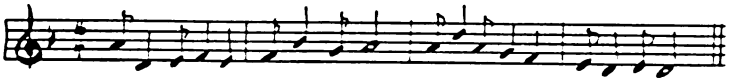
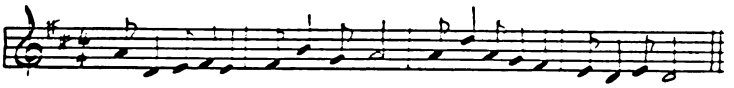
Task I

Melodic Variants	Button Order	Melodic Phrase
Original MM=88 Major	4	
Mode	1	
Rhythm	8	
Tempo MM=66	7	
Mode Rhythm	2	
Mode Tempo MM=66	6	
Rhythm Tempo MM=66	5	
Mode Rhythm Tempo MM=66	3	

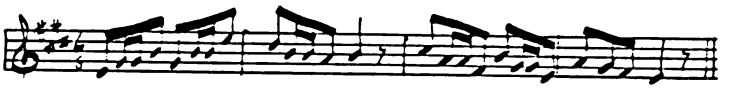
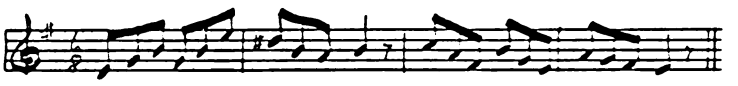
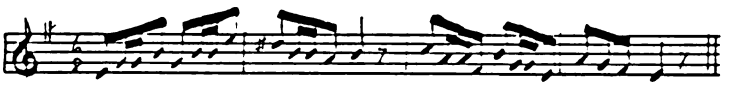
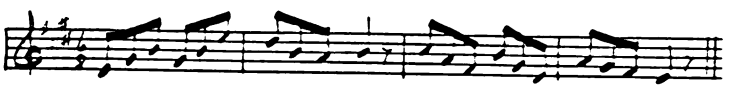
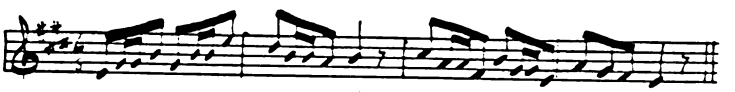
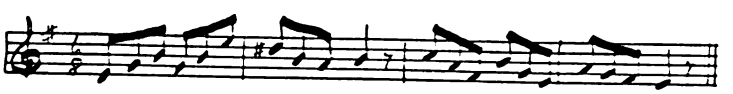
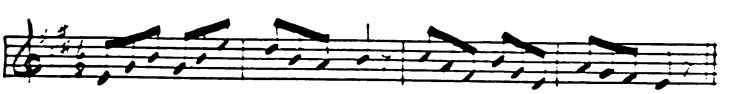
Task II

Melodic Variants	Button Order	Melodic Phrase
Original MM=69 Major	7	
Mode	2	
Rhythm	3	
Tempo MM=88	8	
Mode Rhythm	5	
Mode Tempo MM=88	4	
Rhythm Tempo MM=88	6	
Mode Rhythm Tempo MM=88	1	

Task III

Melodic Variants	Button Order	Melodic Phrase
Original MM=88 Major	2	
Mode	8	
Rhythm	5	
Tempo MM=110	4	
Mode Rhythm	1	
Mode Tempo MM=110	3	
Rhythm Tempo MM=110	7	
Mode Rhythm Tempo MM=110	6	

Task IV

Melodic Variants	Button Order	Melodic Phrase
Original MM=76 Major	5	
Mode	2	
Rhythm	1	
Tempo MM=57	6	
Mode Rhythm	7	
Mode Tempo MM=57	3	
Rhythm Tempo MM=57	4	
Mode Rhythm Tempo MM=57	8	

APPENDIX E

MELODIC STRATEGRAM PROGRAM

APPENDIX E

MELODIC STRATEGRAM PROGRAM

```
1 OPEN #2,4,12,"K:"
2 ? ")"
5 ? ;? ;? ;? ;? ;? ;? ;?
10 ? "          MELODIC STRATEGRAM"
20 ? ;? ;? ;? ;? "        PRESS RETURN TO GO ON"
30 GET #2,S1:IF S1<>155 THEN 30
35 ? ")";? ;? ;? ;?
45 ?
50 ? "THE COMPUTER PROGRAM YOU ARE ABOUT TO"
55 ? "COMPLETE IS COMPRISED OF TWO PARTS."
60 ? "IN PART I YOU WILL BE REQUIRED TO"
65 ? "LISTEN TO A SERIES OF MUSICAL MEL-"
70 ? "ODIES REALIZED ON THE COMPUTER AND"
75 ? "TO DETERMINE DIFFERENCES BETWEEN"
80 ? "THEM."
90 ? ;? ;? ;? ;? "        PRESS RETURN TO GO ON"
95 GET #2,S2:IF S2<>155 THEN 95
100 ? ")";? ;? ;? ;? ;?
110 ? "IN PART II YOU WILL COMPLETE A SHORT"
120 ? "MUSIC LISTINER LEARNING STYLE"
130 ? "INVENTORY THAT WILL UNCOVER SOME OF "
140 ? "THE WAYS IN WHICH YOU APPROACH MUSIC "
150 ? "LISTENING. BE SURE TO READ THE "
160 ? "INSTRUCTIONS AT THE BEGINNING OF EACH"
170 ? "PART CAREFULLY BEFORE ATTEMPTING TO"
180 ? "COMPLETE THE COMPUTER PROGRAM."
190 ? ;? ;? ;? ;? ;? ;? "        PRESS RETURN TO GO ON"
200 GET #2,S3:IF S3<>155 THEN 200
210 ? ")"
220 ? "                PART I"
230 ? ;? ;?
240 ? "YOU ARE ABOUT TO COMPLETE  FOUR (1-4)"
250 ? "SEPARATE MUSICAL TASKS USING A MICRO-"
260 ? "COMPUTER.  PLEASE LOCATE THE LETTER"
270 ? "'O' ON YOUR KEYBOARD. FOR EACH OF THE"
280 ? "FOUR TASKS, THE LETTER 'O' KEY, WHEN"
290 ? "PRESSED, WILL SOUND A NEW MELODY OR"
300 ? "WHAT IS REFERRED TO AS THE 'ORIGINAL'"
310 ? "MELODY."
320 ? ;? ;? ;? "        PRESS RETURN TO GO ON"
330 GET #2,S4:IF S4<>155 THEN 330
340 ? ")";? ;? ;? ;? ;?
350 ? "LOCATE THE KEYS WITH THE NUMBERS"
360 ? "1,2,3,4,5,6,7, AND 8.  EACH TIME YOU"
370 ? "PRESS ONE OF THESE KEYS YOU WILL HEAR"
380 ? "A SHORT MELODY.  YOUR JOB IN EACH OF"
390 ? "THE TASKS IS TO DETERMINE WHICH"
400 ? "MELODY FROM THE 1-8 GROUP SOUNDS"
410 ? "  ALIKE THE 'O' OR ORIGINAL MELODY."
420 ? ;? ;? ;? ;? "        PRESS RETURN TO GO ON"
430 GET #2,S5:IF S5<>155 THEN 430
440 ? ")";? ;? ;? ;? ;?
450 ? "YOU MAY PRESS ANY KEY AT ANY TIME"
460 ? "IN ORDER TO LISTEN TO A PARTICULAR"
470 ? "MELODY.  YOU MAY LISTEN TO A MELODY"
480 ? "AS OFTEN OR AS LITTLE AS YOU FIND"
490 ? "NECESSARY TO ANSWER THE QUESTION."
500 ? ;? ;? ;? ;? "        PRESS RETURN TO GO ON"
510 GET #2,S6:IF S6<>155 THEN 510
520 ? ")";? ;? ;?
530 ? "AFTER COMPLETING EACH MUSICAL TASK"
540 ? "YOU ARE ASKED TO VERBALIZE, WHICH"
550 ? "SIMPLY MEANS YOU ARE TO COMMUNICATE"
560 ? "TO YOUR TASK ADMINISTRATOR HOW "
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560 ? "TO YOUR TASK ADMINISTRATOR HOW "
570 ? "YOU ORGANIZED YOUR LISTENING. EVERY"
580 ? "THOUGHT THAT COMES TO MIND, FOR"
590 ? "EXAMPLE, LISTENING STRATEGY, CHARAC-"
600 ? "TERISTICS OF EACH MELODY- EITHER"
610 ? "IN MUSICAL OR NON-MUSICAL TERMS-,"
620 ? "CONFUSING FACTORS, INSIGHTS OR"
630 ? "DISCOVERIES MADE AS YOU GO ALONG"
640 ? "THAT HELP YOU IN ARRIVING AT YOUR,"
650 ? "SHOULD BE VERBALIZED."
660 ? :? :? "          PRESS RETURN TO GO ON"
670 GET #2,S8:IF S8<>155 THEN 670
680 ? ")":? :? :? :? :? :? :? :? :? :?
690 ? "YOU WILL BE PROVIDED WITH PAPER AND"
700 ? "PENCIL TO ASSIST YOU IF SO DESIRED."
710 ? :? :? "          PRESS RETURN TO GO ON"
720 GET #2,S8:IF S8<>155 THEN 720
730 ? ")":? :? :? :?
740 ? "WHEN YOU HAVE CHOSEN YOUR ANSWER,"
750 ? "PRESS THE 'A' KEY AND THEN TYPE THE"
760 ? "NUMBER KEY THAT REPRESENTS YOUR "
770 ? "ANSWER.  THE MONITOR WILL THEN READ"
780 ? "'IS THIS CORRECT?'  YOU WILL THEN"
790 ? "TYPE THE LETTER 'Y'.  THE COMPUTER"
800 ? "WILL NOW ASK YOU WHICH TASK YOU WISH"
810 ? "TO COMPLETE.  IF YOU HAVE ANY QUES-"
820 ? "TIONS PLEASE ASK BEFORE BEGINING EACH"
830 ? "TASK.  INFORM THE TASK ADMINISTRATOR"
840 ? "WHEN YOU ARE READY TO BEGIN."
850 ? :? :?
860 ? "        PRESS RETURN TO GO ON"
870 GET #2,S9:IF S9<>155 THEN 870
880 ? ")":? :? :? :? :? :? :? :? :?
890 ? "REMEMBER, PROCEED ANY WAY YOU WISH,"
900 ? "AND VERBALIZE YOUR THOUGHTS AS YOU"
910 ? "COMPLETE THIS AURAL PROGRAM."
920 ? :? :? :? "       PRESS RETURN TO GO ON"
930 GET #2,S10:IF S10<>155 THEN 930
1000 ? ") ":? :? :? :? :? :? :? :?
1010 ? "           ARE YOU READY?"
1015 ? :? :?
1020 ? "THE COMPUTER SCREEN WILL BLANK IN"
1030 ? "A MOMENT AND THE DRIVE WILL START."
1040 ? "DO NOT TOUCH THE COMPUTER KEYBOARD"
1050 ? "UNTIL YOU ARE INSTRUCTED TO DO SO."
1065 FOR T=1 TO 350:NEXT T
1070 RUN "D:MELODY"
```

```
10 OPEN #2,4,12,"K:"
15 ? ")"
20 DIM A$(3)
30 DIM TA1$(90)
31 DIM TA2$(90)
32 DIM TA3$(90)
33 DIM TA4$(90)
900 DIM S$(10)
901 ? ")":S$=""
905 ? "PLEASE ENTER YOUR STUDENT ASSESSMENT  IDENTIFICATION NUMBER AND PRESS THE
    RETURN KEY."
910 FOR I=1 TO 10
915 GET #2,KEY:IF KEY=155 THEN 935
920 KEY=KEY-48:IF KEY<0 OR KEY>9 THEN 901
925 ? KEY;:S$(LEN(S$)+1,LEN(S$)+1)=STR$(KEY)
930 NEXT I
935 ?
940 ? "IS THIS CORRECT (Y/N)":GET #2,N:IF N<>89 THEN 901
1000 DIM REC$(128)
1001 ?
1010 ? "YOUR STUDENT ASSESSMENT IDENTIFICATION         NUMBER IS NOW RECORDED"
1015 ?
1020 ? "      PLEASE PRESS RETURN TO START                  THE PROGRAM"
1030 GET #2,ST:IF ST<>155 THEN 1030
1170 ? ")"
1180 ? "PLEASE ENTER THE TASK YOU WISH TO     START ON.  PLEASE PROCEED IN ORDER
."
1181 ? :?
1190 ? "TASK NUMBER 1"
1191 ? :?
1200 ? "       TASK NUMBER 2"
1201 ? :?
1210 ? "              TASK NUMBER 3"
1211 ? :?
1220 ? "                     TASK NUMBER 4"
1230 GET #2,A:IF A<49 OR A>52 THEN 1230
1240 IF A=49 THEN GOSUB 1280
1250 IF A=50 THEN GOSUB 1500
1260 IF A=51 THEN GOSUB 1720
1270 IF A=52 THEN GOSUB 1940
1280 SOUND 0,0,10,8:? ")":? "          YOU HAVE CHOSEN TASK I"
1290 ? "NOW YOU MAY SELECT ANY MELODY YOU WISH TO HEAR FROM 1 TO 8 & 0":IF F=1 T
HEN 1170
1300 GET #2,A:F=2
1301 IF A=79 THEN 1410
1310 IF A=65 THEN GOSUB 10500
1320 IF A<49 OR A>56 THEN 1200
1330 IF A=49 THEN RESTORE 2280:DELAY=425:A$=STR$(A-48):TA1$(LEN(TA1$)+1,LEN(TA1$
)+1)=A$:CMO=CMO+1
1340 IF A=50 THEN RESTORE 2290:DELAY=425:A$=STR$(A-48):TA1$(LEN(TA1$)+1,LEN(TA1$
)+1)=A$:CMT=CMT+1
1350 IF A=51 THEN RESTORE 2300:DELAY=600:A$=STR$(A-48):TA1$(LEN(TA1$)+1,LEN(TA1$
)+1)=A$:CMTH=CMTH+1
1360 IF A=52 THEN RESTORE 2170:DELAY=425:A$=STR$(A-48):TA1$(LEN(TA1$)+1,LEN(TA1$
)+1)=A$:CMF=CMF+1
1370 IF A=53 THEN RESTORE 2350:DELAY=600:A$=STR$(A-48):TA1$(LEN(TA1$)+1,LEN(TA1$
)+1)=A$:CMFI=CMFI+1
1380 IF A=54 THEN RESTORE 2320:DELAY=600:A$=STR$(A-48):TA1$(LEN(TA1$)+1,LEN(TA1$
)+1)=A$:CMS=CMS+1
1390 IF A=55 THEN RESTORE 2250:DELAY=600:A$=STR$(A-48):TA1$(LEN(TA1$)+1,LEN(TA1$
)+1)=A$:CMSE=CMSE+1
1400 IF A=56 THEN RESTORE 2230:DELAY=425:A$=STR$(A-48):TA1$(LEN(TA1$)+1,LEN(TA1$
)+1)=A$:CME=CME+1
1410 IF A=79 THEN RESTORE 2170:DELAY=425:A$=STR$(A-79):TA1$(LEN(TA1$)+1,LEN(TA1$
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1410 IF A=79 THEN RESTORE 2170:DELAY=425:A$=STR$(A-79):TA1$(LEN(TA1$)+1,LEN(TA1$
)+1)=A$:OMR=OMR+1
1430 READ G,HOLD
1440 IF G=-1 THEN 1200
1450 DUR=DELAY*1/HOLD
1460 SOUND 0,G,10,8
1470 GOSUB 1490
1480 GOTO 1430
1490 FOR T=1 TO DUR:NEXT T:SOUND 0,0,0,0:RETURN
1500 SOUND 0,0,0,0:? "):? "      YOU HAVE CHOSEN TASK II":IF F1=1 THEN 1170
1510 ? "YOU MAY SELECT ANY MELODY YOU WISH TO HEAR 1 TO 8 & 0"
1520 GET #2,A:F1=2
1521 IF A=79 THEN 1630
1530 IF A=65 THEN GOSUB 10500
1540 IF A<49 OR A>56 THEN 1500
1550 IF A=49 THEN RESTORE 2610:DELAY=200:A$=STR$(A-48):TA2$(LEN(TA2$)+1,LEN(TA2$
)+1)=A$:TMO=TMO+1
1560 IF A=50 THEN RESTORE 2430:DELAY=300:A$=STR$(A-48):TA2$(LEN(TA2$)+1,LEN(TA2$
)+1)=A$:TMT=TMT+1
1570 IF A=51 THEN RESTORE 2460:DELAY=300:A$=STR$(A-48):TA2$(LEN(TA2$)+1,LEN(TA2$
)+1)=A$:TMTH=TMTH+1
1580 IF A=52 THEN RESTORE 2550:DELAY=200:A$=STR$(A-48):TA2$(LEN(TA2$)+1,LEN(TA2$
)+1)=A$:TMF=TMF+1
1590 IF A=53 THEN RESTORE 2520:DELAY=300:A$=STR$(A-48):TA2$(LEN(TA2$)+1,LEN(TA2$
)+1)=A$:TMFI=TMFI+1
1600 IF A=54 THEN RESTORE 2580:DELAY=200:A$=STR$(A-48):TA2$(LEN(TA2$)+1,LEN(TA2$
)+1)=A$:TMS=TMS+1
1610 IF A=55 THEN RESTORE 2400:DELAY=300:A$=STR$(A-48):TA2$(LEN(TA2$)+1,LEN(TA2$
)+1)=A$:TMSE=TMSE+1
1620 IF A=56 THEN RESTORE 2490:DELAY=200:A$=STR$(A-48):TA2$(LEN(TA2$)+1,LEN(TA2$
)+1)=A$:TME=TME+1
1630 IF A=79 THEN RESTORE 2400:DELAY=300:A$=STR$(A-79):TA2$(LEN(TA2$)+1,LEN(TA2$
)+1)=A$:TMR=TMR+1
1650 READ G,HOLD
1660 IF G=-1 THEN 1500
1670 DUR=DELAY*1/HOLD
1680 SOUND 0,G,10,8
1690 GOSUB 1710
1700 GOTO 1650
1710 FOR T=1 TO DUR:NEXT T:SOUND 0,0,0,0:RETURN
1720 SOUND 0,0,0,0:? "):? "      YOU HAVE CHOSEN TASK III":IF F2=1 THEN 1170
1730 ? " YOU MAY SELECT ANY MELODY YOU WISH TO HEAR FROM 1-8 & 0"
1740 GET #2,A:F2=2
1741 IF A=79 THEN 1840
1745 IF A=65 THEN 10500
1750 IF A<49 OR A>56 THEN 1720
1760 IF A=49 THEN RESTORE 2760:DELAY=355:A$=STR$(A-48):TA3$(LEN(TA3$)+1,LEN(TA3$
)+1)=A$:TMMO=TMMO+1
1770 IF A=50 THEN RESTORE 2640:DELAY=355:A$=STR$(A-48):TA3$(LEN(TA3$)+1,LEN(TA3$
)+1)=A$:TMMT=TMMT+1
1780 IF A=51 THEN RESTORE 2790:DELAY=290:A$=STR$(A-48):TA3$(LEN(TA3$)+1,LEN(TA3$
)+1)=A$:TMMTH=TMMTH+1
1790 IF A=52 THEN RESTORE 2730:DELAY=290:A$=STR$(A-48):TA3$(LEN(TA3$)+1,LEN(TA3$
)+1)=A$:TMMF=TMMF+1
1800 IF A=53 THEN RESTORE 2700:DELAY=355:A$=STR$(A-48):TA3$(LEN(TA3$)+1,LEN(TA3$
)+1)=A$:TMMFI=TMMFI+1
1810 IF A=54 THEN RESTORE 2850:DELAY=290:A$=STR$(A-48):TA3$(LEN(TA3$)+1,LEN(TA3$
)+1)=A$:TMMS=TMMS+1
1820 IF A=55 THEN RESTORE 2820:DELAY=290:A$=STR$(A-48):TA3$(LEN(TA3$)+1,LEN(TA3$
)+1)=A$:TMMSE=TMMSE+1
1830 IF A=56 THEN RESTORE 2670:DELAY=355:A$=STR$(A-48):TA3$(LEN(TA3$)+1,LEN(TA3$
)+1)=A$:TMME=TMME+1
1840 IF A=79 THEN RESTORE 2640:DELAY=355:A$=STR$(A-79):TA3$(LEN(TA3$)+1,LEN(TA3$
)+1)=A$:TMMR=TMMR+1
1870 READ G,HOLD
1880 IF G=-1 THEN 1720
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```
1890 DUR=DELAY*1/HOLD
1900 SOUND 0,G,10,0
1910 GOSUB 1930
1920 GOTO 1870
1930 FOR T=1 TO DUR:NEXT T:SOUND 0,0,0,0:RETURN
1940 SOUND 0,0,0,0:? "):? "      YOU HAVE CHOSEN TASK IV":IF F3=1 THEN 1170
1950 ? " YOU MAY SELECT ANY MELODY YOU WISH TO HEAR FROM 1-8 & 0"
1960 GET #2,A:F3=2
1961 IF A=79 THEN 2070
1965 IF A=65 THEN 10500
1970 IF A<49 OR A>56 THEN 1940
1980 IF A=49 THEN RESTORE 3060:DELAY=175:A$=STR$(A-48):TA$(LEN(TA$)+1,LEN(TA$
)+1)=A$:FMO=FMO+1
1990 IF A=50 THEN RESTORE 3030:DELAY=175:A$=STR$(A-48):TA$(LEN(TA$)+1,LEN(TA$
)+1)=A$:FMT=FMT+1
2000 IF A=51 THEN RESTORE 2910:DELAY=320:A$=STR$(A-48):TA$(LEN(TA$)+1,LEN(TA$
)+1)=A$:FMTH=FMTH+1
2010 IF A=52 THEN RESTORE 2940:DELAY=320:A$=STR$(A-48):TA$(LEN(TA$)+1,LEN(TA$
)+1)=A$:FMFI=FMFI+1
2020 IF A=53 THEN RESTORE 2970:DELAY=175:A$=STR$(A-48):TA$(LEN(TA$)+1,LEN(TA$
)+1)=A$:FMF=FMF+1
2030 IF A=54 THEN RESTORE 2880:DELAY=320:A$=STR$(A-48):TA$(LEN(TA$)+1,LEN(TA$
)+1)=A$:FMS=FMS+1
2040 IF A=55 THEN RESTORE 3000:DELAY=175:A$=STR$(A-48):TA$(LEN(TA$)+1,LEN(TA$
)+1)=A$:FMSE=FMSE+1
2050 IF A=56 THEN RESTORE 3090:DELAY=320:A$=STR$(A-48):TA$(LEN(TA$)+1,LEN(TA$
)+1)=A$:FME=FME+1
2070 IF A=79 THEN RESTORE 2880:DELAY=175:A$=STR$(A-79):TA$(LEN(TA$)+1,LEN(TA$
)+1)=A$:FMR=FMR+1
2090 READ G,HOLD
2100 IF G=-1 THEN 1940
2110 DUR=DELAY*1/HOLD
2120 SOUND 0,G,10,0
2130 GOSUB 2150
2140 GOTO 2090
2150 FOR T=1 TO DUR:NEXT T:SOUND 0,0,0,0:G=0:RETURN
2160 REM TASK
2170 DATA 81,4,86,8,96,8,108,4,64,4,72,8,64,8,60,8,72,8,64,8,81,8,108,4,60,4,64,
8,60,8,64,4,72,4,108,8
2180 DATA 96,8,86,8,108,8,81,2,-1,-1
2190 REM MELODY 1
2200 DATA 81,4,86,8,102,8,108,4,68,4,72,8,68,8,68,8,72,8,68,8,81,8,108,4,68,4,68
,8,68,8,68,4,72,4,108,8
2210 DATA 102,8,86,8,108,8,81,2,-1,-1
2220 REM MELODY 8
2230 DATA 81,4,86,6,96,16,108,6,108,16,64,4,72,6,64,16,68,6,72,16,64,6,81,16,108
,4,68,4,64,6,68,16,64,6,64,16,72
2240 DATA 4,108,6,96,16,86,6,108,16,81,2,-1
2250 REM MELODY 7
2260 DATA 81,4,86,8,96,8,108,4,64,4,72,8,64,8,60,8,72,8,64,8,81,8,108,4,60,4,64,
8,60,8,64,4,72,4,108
2270 DATA 8,96,8,86,8,108,8,81,2,-1,-1
2280 REM MELODY 2
2290 DATA 81,4,86,6,102,16,108,6,108,16,68,4,72,6,68,16,68,6,72,16,68,6,81,16,10
8,4,68,4,68,6,68,16,68,6,68,16,72
2300 DATA 4,108,6,102,16,86,6,108,16,81,2,-1
2310 REM MELODY 6
2320 DATA 81,4,86,8,102,8,108,4,68,4,72,8,68,8,68,8,72,8,68,8,81,8,108,4,68,4,68
,8,68,8,68,4,72,4,108,8
2330 DATA 102,8,86,8,108,8,81,2,-1
2340 REM MELODY 5
2350 DATA 81,4,86,6,96,16,108,6,108,16,64,4,72,6,64,16,68,6,72,16,64,6,81,17,108
,4,68,4,64,6,68,16,64,6,64,16,72
2360 DATA 4,108,6,96,16,86,6,108,16,81,2,-1
2370 REM MELODY 3
2380 DATA 81,4,86,6,102,16,108,6,108,16,68,4,72,6,68,16,68,6,72,16,68,6,81,16,10
```

```
8,4,60,4,68,6,60,16,68,6,68,16
2390 DATA 72,4,108,6,102,16,86,6,108,16,81,2,-1
2400 REM TASK 2:MELODY 7,8
2410 DATA 81,6,72,16,81,8,91,6,81,16,91,8,96,8,108,8,121,8,108,4,8,8,72,6,91,16,
72,8,64,6,81,16,64,8,60,4,8,8,81,4
2420 DATA 8,8,-1
2430 REM MELODY 2
2440 DATA 81,6,76,16,81,8,91,6,81,16,91,8,102,8,108,8,121,8,108,4,8,8,76,6,91,16
,76,8,64,6,81,16,64,8,60,4,8,8,81
2450 DATA 4,8,8,-1
2460 REM MELODY 3
2470 DATA 81,8,72,8,81,8,91,8,81,8,91,8,96,8,108,8,121,8,108,4,8,8,72,8,91,8,72,
8,64,8,81,8,64,8,60,4,8,8,81,4,8,8
2480 DATA -1
2490 REM MELODY 8
2500 DATA 81,6,72,16,81,8,91,6,81,16,91,8,96,8,108,8,121,8,108,4,8,8,72,6,91,16,
72,8,64,6,81,16,64,8,60,4,8,8,81,4
2510 DATA 8,8, -1
2520 REM MELODY 5
2530 DATA 81,8,76,8,81,8,91,8,81,8,91,8,102,8,108,8,121,8,108,4,8,8,76,8,91,8,76
,8,64,8,81,8,64,8,60,4,8,8,81,4
2540 DATA 8,8,-1
2550 REM MELODY 4
2560 DATA 81,6,76,16,81,8,91,6,81,16,91,8,102,8,108,8,121,8,108,4,8,8,76,6,91,16
,76,8,64,6,81,16,64,8,60,4,8,8,81
2570 DATA 4,8,8,-1,-1
2580 REM MELODY 6
2590 DATA 81,8,72,8,81,8,91,8,81,8,91,8,96,8,108,8,121,8,108,4,8,8,72,8,91,8,72,
8,64,8,81,8,64,8,60,4,8,8,81,4,8,8
2600 DATA -1,-1
2610 REM MELODY 1
2620 DATA 81,8,76,8,81,8,91,8,81,8,91,8,102,8,108,8,121,8,108,4,8,8,76,8,91,8,76
,8,64,8,81,8,64,8,60,4,8,8,81,4,8
2630 DATA 8, -1,-1
2640 REM TASK 3: MELODY 2+8
2650 DATA 72,6,108,16,108,6,96,16,91,4,96,4,91,6,68,16,72,6,81,16,72,2,72,6,53,1
6,53,6,72,16,81,4,91,4,96
2660 DATA 6,108,16,96,6,91,16,108,2,-1
2670 REM MELODY 8
2680 DATA 72,6,108,16,108,6,96,16,86,4,96,4,86,6,64,16,72,6,81,16,72,2,72,6,53,1
6,53,6,72,16,81,4,86,4,96
2690 DATA 6,108,16,96,6,86,16,108,2,-1
2700 REM MELODY 5
2710 DATA 72,8,108,4,96,8,91,4,96,4,91,8,68,4,81,8,72,2,72,8,53,4,72,8,81,4,91,4
,96,8,108,4,96,8
2720 DATA 108,2,-1
2730 REM MELODY 4
2740 DATA 72,6,108,16,108,6,96,16,91,4,96,4,91,6,68,16,72,6,81,16,72,2,72,6,53,1
6,53,6,72,16,81,4,91,4,96
2750 DATA 6,108,16,96,6,91,16,108,2,-1
2760 REM MELODY 1
2770 DATA 72,8,108,4,96,8,86,4,96,4,86,8,64,4,81,8,72,2,72,8,53,4,72,8,81,4,86,4
,96,8,108,4,96,8
2780 DATA 108,2,-1
2790 REM MELODY 3
2800 DATA 72,6,108,16,108,6,96,16,86,4,96,4,86,6,64,16,72,6,81,16,72,2,72,6,53,1
6,53,6,72,16,81,4,86,4,96
2810 DATA 6,108,16,96,6,86,16,108,2,-1
2820 REM MELODY 7
2830 DATA 72,8,108,4,96,8,91,4,96,4,91,8,68,4,81,8,72,2,72,8,53,4,72,8,81,4,91,4
,96,8,108,4,96,8
2840 DATA 108,2,-1
2850 REM MELODY 6
2860 DATA 72,8,108,4,96,8,86,4,96,4,86,8,64,4,81,8,72,2,72,8,53,4,72,8,81,4,86,4
,96,8,108,4,96,8
2870 DATA 108,2,-1
```

```
2880 REM TASK 4;MELODY 6+8
2890 DATA 96,8,81,16,81,16,64,8,81,8,64,16,64,16,47,8,50,8,64,16,64,16,72,8,64,4
,8,8,60,8,72,16,72,16,86,8,64
2900 DATA 8,81,16,81,16,96,8,72,8,81,8,86,8,96,4,8,8,-1
2910 REM MELODY 3
2920 DATA 96,8,76,16,76,16,64,8,76,8,64,16,64,16,47,8,50,8,64,16,64,16,72,8,64,4
,8,8,57,8,72,16,72,16
2930 DATA 86,8,64,8,76,16,76,16,96,8,72,8,76,8,86,8,96,4,8,8,-1
2940 REM MELODY 4
2950 DATA 96,8,81,8,64,8,81,8,64,8,47,8,50,8,64,8,72,8,64,4,8,8,60,8,72,8,86,8,6
4,8,81,8,96,8,72,8
2960 DATA 81,8,86,8,96,4,8,8,-1
2970 REM MELODY 5
2980 DATA 96,8,81,16,81,16,64,8,81,8,64,16,64,16,47,8,50,8,64,16,64,16,72,8,64,4
,8,8,60,8,72,16,72,16,86,8
2990 DATA 64,8,81,16,81,16,96,8,72,8,81,8,86,8,96,4,8,8,-1,-1
3000 REM MELODY 7
3010 DATA 96,8,76,8,64,8,76,8,64,8,47,8,50,8,64,8,72,8,64,4,8,8,57,8,72,8,86,8,6
4,8,76,8,96,8,72,8,76
3020 DATA 8,86,8,96,4,8,8,-1,-1
3030 REM MELODY 2
3040 DATA 96,8,76,16,76,16,64,8,76,8,64,16,64,16,47,8,50,8,64,16,64,16,72,8,64,4
,8,8,57,8,72,16,72,16,86,8
3050 DATA 64,8,76,16,76,16,96,8,72,8,76,8,86,8,96,4,8,8,-1
3060 REM MELODY 1
3070 DATA 96,8,81,8,64,8,81,8,64,8,47,8,50,8,64,8,72,8,64,4,8,8,60,8,72,8,86,8,6
4,8,81,8,96,8,72,8,81
3080 DATA 8,86,8,96,4,8,8,-1,-1
3090 REM MELODY 8
3100 DATA 96,8,76,8,64,8,76,8,64,8,47,8,50,8,64,8,72,8,64,4,8,8,57,8,72,8,86,8,6
4,8,76,8,96,8,72,8,76,8,86
3110 DATA 8,96,4,8,8,-1,-1
4000 ? "}"
4010 ? "THE STUDENT ASSESSMENT IDENTIFICATION            NUMBER IS    ";S$
4015 ? :? :? :?
4020 ? "   PRESS RETURN TO GO TO TASK DATA                INFORMATION"
4025 GET #2,TO:IF TO<>155 THEN 4025
4030 ? "}"
4040 ? "              TASK ONE DATA"
4045 ? "THE ORDER OF THE MELODY SELECTION WILL APPEAR ON THE NEXT LINE."
4050 ? TA1$
4051 ?
4060 ? "THE NUMBER OF TIMES EACH MELODY WAS   CHOSEN WILL APPEAR BELOW IN VERTIC
AL  COLUMNS."
4080 ? "#1",OMO
4081 ? "#2",OMT
4082 ? "#3",OMTH
4083 ? "#4",OMF
4084 ? "#5",OMFI
4085 ? "#6",OMS
4086 ? "#7",OMSE
4087 ? "#8",OME
4088 ? "ORIGINAL",OMR
4190 ?
4200 ? "THE USER'S ANSWER TO TASK #1 WILL        APPEAR ON THE LINE BELOW."
4210 ? "TASK #1  ";REC$(1,1)
4215 ?
4220 ? "PRESS RETURN FOR NEXT TASK SCREEN":GET #2,NS:IF NS<>155 THEN 4220
5030 ? "}"
5040 ? "              TASK TWO DATA"
5045 ? "THE ORDER OF THE MELODY SELECTION WILL APPEAR ON THE NEXT LINE."
5050 ? TA2$
5051 ?
5060 ? "THE NUMBER OF TIMES EACH MELODY WAS   CHOSEN WILL APPEAR BELOW IN VERTIC
AL  COLUMNS."
5080 ? "#1".TMO
```

```
5001 ? "#2",TMT
5002 ? "#3",TMTH
5003 ? "#4",TMF
5004 ? "#5",TMFI
5005 ? "#6",TMS
5006 ? "#7",TMSE
5007 ? "#8",TME
5008 ? "ORIGINAL",TMR
5190 ?
5200 ? "THE USER'S ANSWER TO TASK #2 WILL       APPEAR ON THE LINE BELOW."
5210 ? "TASK #2  ";REC$(2,2)
5215 ?
5220 ? "PRESS RETURN FOR NEXT TASK SCREEN":GET #2,NS:IF NS<>155 THEN 5220
6030 ? ")"
6040 ? "             TASK THREE DATA"
6045 ? "THE ORDER OF THE MELODY SELECTION WILL APPEAR ON THE NEXT LINE."
6050 ? TA3$
6051 ?
6060 ? "THE NUMBER OF TIMES EACH MELODY WAS   CHOSEN WILL APPEAR BELOW IN VERTIC
AL  COLUMNS."
6080 ? "#1",THMO
6081 ? "#2",THMT
6082 ? "#3",THMTH
6083 ? "#4",THMF
6084 ? "#5",THMFI
6085 ? "#6",THMS
6086 ? "#7",THMSE
6087 ? "#8",THME
6088 ? "ORIGINAL",THMR
6190 ?
6200 ? "THE USER'S ANSWER TO TASK #3 WILL       APPEAR ON THE LINE BELOW."
6210 ? "TASK #3  ";REC$(3,3)
6215 ?
6220 ? "PRESS RETURN FOR NEXT TASK SCREEN":GET #2,NS:IF NS<>155 THEN 6220
7030 ? ")"
7040 ? "             TASK FOUR DATA"
7045 ? "THE ORDER OF THE MELODY SELECTION WILL APPEAR ON THE NEXT LINE."
7050 ? TA4$
7051 ?
7060 ? "THE NUMBER OF TIMES EACH MELODY WAS   CHOSEN WILL APPEAR BELOW IN VERTIC
AL  COLUMNS."
7080 ? "#1",FMO
7081 ? "#2",FMT
7082 ? "#3",FMTH
7083 ? "#4",FMF
7084 ? "#5",FMFI
7085 ? "#6",FMS
7086 ? "#7",FMSE
7087 ? "#8",FME
7088 ? "ORIGINAL",FMR
7190 ?
7200 ? "THE USER'S ANSWER TO TASK #4 WILL       APPEAR ON THE LINE BELOW."
7210 ? "TASK #4  ";REC$(4,4)
7215 ?
7220 ? "PRESS RETURN FOR NEXT TASK SCREEN":GET #2,NS:IF NS<>155 THEN 7220
7300 ? ")"
7310 ? "THANK YOU. THE MELODIC STRATEGRAM IS  NOW COMPLETE AND THE COMPUTER WILL
"
7315 ? "RESET. THE COMPUTER IS NOW LOADING"
7316 ? "THE INSTRUCTIONS. DO NOT TOUCH. THANK YOU."
7320 FOR T=1 TO 500:NEXT T:RUN "D:MENU"
10200 REM INSTALLATION OF ARRAY
10300 Q=Q-48:A=A-48
10500 ? "PLEASE ENTER YOUR ANSWER"
10505 IF F=2 THEN F=1
10506 IF F1=2 THEN F1=1
```

```
10587 IF F2=2 THEN F2=1
10588 IF F3=2 THEN F3=1
10600 GET #2,V:IF V<48 OR V>56 THEN 10588
10650 ? CHR$(V);? "IS THIS CORRECT (Y/N)"
10700 GET #2,L:IF L<>89 THEN 10588
10800 IF L=89 THEN 10900
10900 XY=LEN(REC$)
10901 Z=Z+1
10902 V=V-48
11000 REC$(XY+1,XY+1)=STR$(V)
11100 IF Z=4 THEN 11300
11200 GOTO 1170
11300 ? ")"
11400 ? "PLEASE INFORM YOUR TASK ADMINISTRATOR          THAT PART I IS COMPLETE"
11500 FOR T=1 TO 750:NEXT T
11600 Z=0:GOTO 4000
```

APPENDIX F

STUDENT PROTOCOL

STUDENT PROTOCOL

1 Absence of Formal Operational Thought		2 Intermediate Formal Operational Thought		3 Absolute Formal Operational Thought	
/ / /	no statement of how student is going to proceed	/ / /	a statement of how a student thinks he is going to proceed, either unsystematic or vague	/ / /	a clear, systematic statement of how student is going to proceed in solving the task
/ / /	inability to isolate more than one of the three variables of rhythm, mode or tempo	/ / /	isolation of at least two out of the three variables of rhythm, mode or tempo	/ / /	isolation of the variables of rhythm, mode and tempo
/ / /	experimental exhaustion of less than eight of the melodic choices	/ / /	experimental exhaustion of all eight melodic choices	/ / /	experimental exhaustion of all eight melodic choices
/ / /	verbalization of less than four of the variables present in each of the eight melodic choices	/ / /	verbalization of more than four but less than eight of the variables present in each of the eight melodic choices	/ / /	verbalization of the variables present in each of the eight melodic choices

Student Assessment ID _____

Answers / / /

Strategies I _____

II _____

III _____

IV _____

Comments: _____

_____

_____

_____

APPENDIX G

MUSIC LISTENER LEARNING STYLE INVENTORY

APPENDIX G

MUSIC LISTENER LEARNING STYLE INVENTORY

Directions: Circle the number that reflects how you feel about each statement.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. I prefer an unlimited amount of time to complete music listening tasks.	1	2	3	4	5
2. I found it easy to complete the four listening tasks (easy to concentrate and didn't have to repeat many melodies).	1	2	3	4	5
3. Making decisions quickly on what I am hearing in music works better for me than taking time for reflection.	1	2	3	4	5
4. I have a predetermined plan or strategy as I began the first task.	1	2	3	4	5
5. I developed a strategy for music listening that helped me as I continued completing the tasks.	1	2	3	4	5
6. I can aurally distinguish melodies that are changed in more than one way every easily.	1	2	3	4	5
7. I prefer listening to a melody a number of times before making comparisons to other melodies.	1	2	3	4	5
8. I prefer to listen to a melody at regular intervals during a listening task as opposed to numerous hearings at the outset of the task.	1	2	3	4	5
9. The number of times (repetitions) I listen to a melody is an indication of some aural difficulty for me.	1	2	3	4	5
10. Verbalizing (talking) about that I am hearing in music helps me to focus more indepth on what is happening.	1	2	3	4	5
11. Verbalizing (writing) about what I am hearing in music helps me to focus more indepth on what is happening.	1	2	3	4	5
12. I prefer to listen to music performed on orchestral instruments rather than realized on a computer.	1	2	3	4	5
13. I feel that the Melodic Strategram would be an effective ear-training program.	1	2	2	4	5

APPENDIX H

RESEARCH APPROVAL DOCUMENTS

APPENDIX H

RESEARCH APPROVAL DOCUMENTS

March 26, 1985

TO: University Committee on Research Involving Human Subjects
Dr. Henry Bredeck

FROM: Barbara R. Hiranpradist, Doctoral Candidate in Music Education
Michigan State University

RE: Material submitted for review

1. ABSTRACT:

The study herein is this researcher's proposed dissertation topic. Serving as the focus of the study is the reasoning operation of combinatorial logic, one aspect of Jean Piaget's formal operational stage of cognitive development. The problem under investitation is to uncover the degree to which university students exhibit a systematic problem-solving strategy in arriving at their correct task response, in this study being an aural decision based upon melodies and their transformations. Problem solving, or hypothesis testing, is addressed by Piaget in his fourth stage of cognitive development, formal operations. The formal operational aspect of the present experiment will be the subjects' adherence to (a) a systematic strategy versus trial and error, and (b) musical variable isolation and exhaustion in pursuing a solution to a musical problem.

The assessment will be administered through a computer program designed by this researcher for the Atari 800XL computer. Part I consists of the musical component of the program, thirty-two short melodies realized on the computer. Part II consists of a thirteen-item Music Listener Learning Style Inventory that reflects different aspects of learning styles as germane to the aural tasks.

Eight keys, each programmed with a different transformation of a task melody, will be manipulated by each subject after verbal

instructions by this researcher and printed instructions on the computer monitor. A separate key will be designated "task 1 (2,3,4)," the melody to which each of the eight transformations will be compared. The subject will be allowed unlimited time to arrive at his answer, the transformation that sounds least like the original melody.

Implementing the computer segment of the program will be a clinical-type interview where the subjects will be required to explain their problem-solving strategy during task completion. A student protocol form, which categorizes listening and verbal responses, will be used by this researcher to log data from Part I. In tandem, the two data-gathering procedures will provide this researcher with the following information: (a) individual learning style profile data, and (b) a self-report of the subjects' problem-solving strategy.

The computer program will be administered to a volunteer sample of five music and five nonmusic major students at the beginning of Spring Term 1985 as a pilot test. Following necessary revision, the final form of the assessment will be administered to 40 music and 40 nonmusic major students between the ages of 18 and 22 years. Results of the test will be analyzed to assess differences in the overall performance of each group, and relationships between learning styles and problem-solving strategies.

2. Student population:

Michigan State University students currently enrolled in both music and elementary education curriculums are the target population. This researcher will solicit volunteers in the following manner (a) seek cooperation of Aural Harmony and Music 135 instructors to allot class time for explanation of the research study, (b) obtain a list of names and phone numbers of students interested in participating, and (c) schedule a time, not in excess of one hour, convenient to both the student and test adminstrator.

3. Risk/benefit ratio:

Risks are nonexistent. The aural analysis required in this study will present a challenge in the areas of perceptual ability and verbal communication. The computer program will give the subjects a unique opportunity to solve tasks in music via the microcomputer. In the area of music research, this study will provide additional information in the problem-solving strategies of music and nonmusic majors.

University Committee on Research Involving Human Subjects
March 26, 1985
Page 3

4. Consent procedures:

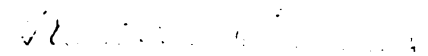
A consent form, in addition to a brief explanation of the study, will be provided in the form of a cover letter.

5. Copy of consent form:

Dear Student:

As the topic of my doctoral dissertation, I have chosen to investigate a construct of formal operational thought or hypothesis testing as described by Jean Piaget, a developmental psychologist. Simply stated, the study will attempt to measure your aural and verbal responses to musical tasks presented via a computer program. The study will focus on the strategy you employ to arrive at your answer. The program is four tasks in length and will take about 45 minutes to complete. The Music Listener Learning Style Inventory, a segment of the study, is designed to gather information on your personal learning style in aural musical tasks to assist me in determining relationships with task strategies. You will be identified by a student identification number only, and all information is confidential. You may withdraw from the study at any time without penalty. Upon request, you may obtain the results of your individual performance. Your participation is greatly appreciated.

Sincerely,



Barbara R. Hiranpradist
337-2197

University Committee on Research Involving Human Subjects
March 26, 1985
Page 4

Consent:

I am freely volunteering to participate in this research study and understand that all information is confidential and that I may withdraw from the study at any time without penalty.

Signed _____ Date _____

Home Phone _____ Major _____
Music/nonmusic

6. Information-gathering instruments:

   Copies of the Music Listener Learning Style Profile and Student Protocol are included with this request statement.

7. Graduate research:

   Doctoral dissertation in music education:

   FORMAL OPERATIONAL THOUGHT AS A DIMENSION

   OF MUSIC LISTENER BEHAVIOR

8. Full research proposal:

   In lieu of the full research proposal, a copy of the "procedure" section of the proposal has been forwarded.

   Additional information:

   Barbara R. Hiranpradist
   337-2197

MICHIGAN STATE UNIVERSITY

UNIVERSITY COMMITTEE ON RESEARCH INVOLVING
HUMAN SUBJECTS (UCRIHS)
230 ADMINISTRATION BUILDING
(517) 355-2186

EAST LANSING • MICHIGAN • 48824-1046

March 29, 1985

Ms. Barbara R. Hiranpradist
Department of Music Education

Dear Ms. Hiranpradist:

Subject: Proposal Entitled, "Formal Operational Thought as a Dimension of Music Listener Behavior"

I am pleased to advise that I concur with your evaluation that this project is exempt from full UCRIHS review, and approval is herewith granted for conduct of the project.

You are reminded that UCRIHS approval is valid for one calendar year. If you plan to continue this project beyond one year, please make provisions for obtaining appropriate UCRIHS approval prior to March 29, 1986.

Any changes in procedures involving human subjects must be reviewed by the UCRIHS prior to initiation of the change. UCRIHS must also be notified promptly of any problems (unexpected side effects, complaints, etc.) involving human subjects during the course of the work.

Thank you for bringing this project to my attention. If I can be of any future help, please do not hesitate to let me know.

Sincerely,

Henry E. Bredeck
Chairman, UCRIHS

HEB/jms

cc: Dr. Robert Erbes

APPENDIX I

PILOT TEST INVENTORY AND RESULTS

APPENDIX I

PILOT TEST INVENTORY AND RESULTS

Pilot Test

Music Listener Learning Style Inventory

1 = Strongly disagree 2 = Strongly agree

1.	I prefer an unlimited amount of time to complete music listening tasks.	1	2	3	4	5
2.	In general, it was difficult for me to complete the four musical tasks (had to think and repeat a lot of the listenings).	1	2	3	4	5
3.	I had a predetermined plan or strategy as I began the first task.	1	2	3	4	5
4.	I developed a strategy for music listening that helped me as I continued completing the tasks.	1	2	3	4	5
5.	I found that listening to more than one change in the musical examples was difficult for me.	1	2	3	4	5
6.	I would prefer to listen to a melody a number of times before making comparisons to other melodies.	1	2	3	4	5
7.	I think my answer was correct.	1	2	3	4	5
8.	I would have preferred to have heard the melodies performed on orchestral instruments rather than realized on a computer.	1	2	3	4	5
9.	The number of times (repetitions) I listened to each melody is an indication of some aural difficulty for me.	1	2	3	4	5

Pilot Test--Music Major Students

Student ID No.	Age	Sex M=1 F=2	Time on Tasks (Minutes) #1 #2 #3 #4	F.O. Score	Task Answers	Inventory Answers		Strategies Task 4
						Section A	Section B	
1	-	-	- - - -	2	3587	521512543	-	001122334455
2	-	-	- - - -	2	6518	425113452	-	101203040556
3	-	-	- - - -	2	3138	525422534	-	01234056780
4	-	-	- - - -	2	2118	325222532	-	01234567824
5	-	-	- - - -	3	3168	525122533	-	0123456787

Pilot Test--Non-Music Major Students

Student ID No.	Age	Sex M=1 F=2	Time on Tasks (Minutes) #1 #2 #3 #4	F.O. Score	Task Answers	Inventory Answers		Strategies Task 4
						Section A	Section B	
1	-	-	- - - -	2	3568	555425343	-	01020345
2	-	-	- - - -	2	5567	325543533	-	010203345
3	-	-	- - - -	2	6168	541444413	-	012345678078
4	-	-	- - - -	2	3568	535512543	-	012304560780
5	-	-	- - - -	1	2171	343353445	-	012304506708

APPENDIX J

ANALYSIS OF VARIANCE AND LISTENING STRATEGY DATA

APPENDIX J

ANALYSIS OF VARIANCE AND LISTENING STRATEGY DATA

Results of the F-Test: Inventory Statements on Performance Scores and Majors

Source of Variation	Statement	Sum of Squares	DF	Mean Square	F
Performance Scores	#1	0.312	1	0.213	0.256
Major		0.120	1	0.120	0.099
Interaction		0.952	1	0.952	0.783
Within		82.680	68	1.216	
Total		83.944	71	1.182	
Performance Scores	#2	1.742	1	1.742	1.344
Major		7.778	1	7.778	5.999
Interaction		1.844	1	1.844	1.422
Within		88.163	68	1.297	
Total		112.875	71	1.590	
Performance Scores	#3	0.225	1	0.225	0.144
Major		0.524	1	0.524	0.335
Interaction		0.099	1	0.099	0.064
Within		106.315	68	1.563	
Total		108.319	71	1.526	
Performance Scores	#4	1.403	1	1.403	0.685
Major		0.074	1	0.074	0.036
Interaction		0.001	1	0.001	0.001
Within		139.235	68	2.048	
Total		140.986	71	1.986	
Performance Scores	#5	1.926	1	1.926	3.663
Major		0.189	1	0.189	0.360
Interaction		0.217	1	0.217	0.413
Within		35.746	68	0.526	
Total		40.611	71	0.572	

Results of the F-Test: Inventory Statements on Performance Scores and Majors

Source of Variation	Statement	Sum of Squares	DF	Mean Square	F
Performance Scores	#6	1.324	1	1.324	2.035
Major		8.918	1	8.918	13.703
Interaction		0.200	1	0.200	0.308
Within		44.253	68	0.651	
Total		68.00	71	0.958	
Performance Scores	#7	1.066	1	1.066	0.731
Major		0.143	1	0.143	0.098
Interaction		0.000	1	0.000	0.000
Within		99.129	68	1.458	
Total		101.875	71	1.435	
Performance Scores	#8	0.165	1	0.160	0.160
Major		2.858	1	2.858	2.778
Interaction		0.632	1	0.632	0.614
Within		69.953	68	1.029	
Total		76.875	71	1.083	
Performance Scores	#9	1.568	1	1.568	1.342
Major		0.022	1	0.022	0.019
Interaction		0.848	1	0.848	0.726
Within		79.473	68	1.169	
Total		83.278	71	1.173	
Performance Scores	#10	0.018	1	0.018	0.019
Major		0.707	1	0.707	0.729
Interaction		2.139	1	2.139	2.206
Within		65.953	68	0.970	
Total		69.500	71	0.979	
Performance Scores	#11	0.258	1	0.258	0.315
Major		5.093	1	5.093	6.228
Interaction		0.883	1	0.883	1.079
Within		55.610	68	0.818	
Total		62.875	71	0.886	
Performance Scores	#12	2.069	1	2.069	2.245
Major		3.299	1	3.299	3.579
Interaction		4.973	1	4.973	5.395
Within		62.680	68	0.922	
Total		71.111	71	1.002	

Results of the F-Test: Inventory Statements on Performance Scores and Majors

Source of Variation	Statement	Sum of Squares	DF	Mean Square	F
Performance Scores	#13	0.351	1	0.351	0.921
Major		0.311	1	0.311	0.817
Interaction		0.351	1	0.351	0.920
Within		25.910	68	0.381	
Total		28.000	71	0.394	

Music Major Students (N=36)

Student ID#	Age	Sex M=1 F=2	Time on Tasks (Minutes) #1	#2	#3	#4	F.O. Score	Task Answers	Inventory answers Section A	Strategies Task #4
201	20	2	08	04	04	05	2	1513	522434524245 4	000120134012
202	21	1	07	06	09	08	2	3518	534153244344 4	001234567801
203	21	2	04	02	04	05	3	3514	511434523545 5	012034567801
204	22	1	02	06	07	06	3	2567	224145242444 4	001202345678
205	20	1	07	01	02	04	2	2312	224535242243 4	012034067812
206	20	2	03	03	03	02	2	3517	544444234443 5	012345678702
207	22	2	03	03	01	01	3	3168	455255145255 5	001234567800
208	20	1	06	04	04	05	3	3168	343244434345 5	000120340506
209	19	1	10	06	04	06	3	3167	542554533242 5	000123405670
210	21	2	08	06	05	04	3	3168	513155141455 5	001234506780
211	18	1	05	04	04	05	3	3568	344444423243 4	001012345678
212	20	2	03	02	03	02	3	3168	554445423554 4	000123405670
213	18	1	03	03	03	02	3	3168	553155335445 3	012345678780
214	21	2	05	04	07	04	3	3568	544243224445 3	000123450607
215	19	2	07	08	04	05	3	3168	433144134345 5	000120345067
216	18	1	05	03	08	04	3	3468	343134422435 4	000123456783
217	20	2	05	03	09	03	3	3168	444555144355 5	001203456078
218	22	2	11	06	07	06	3	3168	442445442255 5	001202304567
219	19	2	04	04	05	04	2	2118	222444242434 4	010234056771
220	18	1	03	03	03	02	2	2414	253144424445 4	001023456781
221	19	2	03	03	03	02	3	3168	455354234344 4	001203415067
222	18	2	06	04	04	05	3	3168	443455521244 3	001234567803
223	20	1	05	04	05	05	3	3168	542444252344 4	001202345067
224	23	2	09	04	06	06	3	2168	542254243443 5	001234056787
225	19	1	04	04	03	03	2	3418	545555243555 5	012345617802
226	19	1	08	07	05	05	3	3168	342354343435 5	000001234067
227	19	2	12	07	08	07	3	3168	521454541152 4	000012034005
228	19	2	06	09	02	05	3	3168	532253444444 4	000011020230
229	22	2	04	03	05	04	2	3438	542254524554 4	000123056783
230	19	2	06	05	05	05	3	2168	433445454533 5	000012030345
231	21	2	06	05	04	05	3	2168	451255432454 4	001234567 08
232	20	1	03	03	05	04	3	3168	245444414354 4	000123404567
233	21	2	04	04	05	04	2	2434	522243244444 5	012345678 04
234	22	1	03	04	04	04	3	3168	155145145255 2	012345067808
235	22	2	07	05	07	06	3	2118	434454454445 5	001200340505
236	22	2	04	05	05	03	2	3564	422434242454 5	001203450670

Non-Music Major Students (N=36)

Student ID#	Age	Sex M=1 F=2	Time on Tasks (Minutes) #1	#2	#3	#4	F.O. Score	Task Answers	Inventory answers Section A	Strategies Task #4
101	20	2	06	03	05	06	2	2117	2224224542435	000120203003
102	18	2	08	01	01	08	2	3567	4224442344444	000123041560
103	22	2	05	05	06	09	2	2361	5211412444425	010203040506
104	19	2	03	02	04	04	2	2254	5445434355455	001234567801
105	22	2	06	05	02	06	2	2487	4234333443335	008070605043
106	19	2	06	03	05	03	2	2134	4443452424255	010234056780
107	20	2	02	06	08	05	2	2685	4221432422445	001023045607
108	22	2	02	01	03	04	2	2134	4124442544455	000120340567
109	20	2	04	04	08	10	2	3464	4141432543445	001020304050
110	22	1	02	04	07	06	2	2158	4212534544525	011002303434
111	21	2	05	05	06	06	3	3158	4242422434224	012303450678
112	22	2	06	08	15	10	2	6438	5114512554535	012304050567
113	18	2	03	04	05	04	2	2518	4423432444435	001234056710
114	21	2	05	03	04	06	2	5268	4224545344544	000010022033
115	22	1	07	05	07	05	2	3367	2244334453234	000102034506
116	22	2	03	04	05	06	2	8161	2241322332253	012010340560
117	21	2	05	04	06	04	2	4154	5123423525445	21020334026
118	22	2	08	07	15	02	2	8153	2242242543455	01203405607
119	21	2	07	03	04	04	2	3114	5124434234455	001203345678
120	22	2	06	04	08	05	2	2114	3121422444434	010234567801
121	22	2	05	07	06	06	2	3111	2121222434345	012304506780
122	20	2	20	10	10	08	3	3868	4213533434534	001203450707
123	22	1	07	05	03	04	2	3137	5444442525544	010203405607
124	19	1	05	04	06	04	2	2418	4434544243455	000012345678
125	22	2	06	07	08	03	3	2168	5221444225134	001234567804
126	22	1	03	02	03	04	2	1162	4455433224445	01234456702
127	21	2	05	03	05	04	2	3117	5354431454435	0876543210
128	21	1	07	05	07	04	2	2567	5415444224555	200102340562
129	20	1	03	03	04	03	2	2415	4235432455144	01201314510
130	19	2	05	04	05	06	2	6517	4222432524435	012034506658
131	22	2	03	04	06	06	2	3518	5421543434554	012345678000
132	19	2	04	03	05	02	2	2171	3224432534435	001023404560
133	19	2	05	03	05	04	3	3568	5355543434525	012304560780
134	22	2	06	04	05	05	2	2118	3422443442445	010230045678
135	18	1	08	04	05	07	2	6517	4244332442254	012030123456
136	19	2	06	04	04	03	2	2133	5444442424544	006223456780

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