AN ABSTRACT OF THE THESIS OF

Robert E. Fisher for the Master of Music degree

in Music Education presented on May 20, 1977

Title: An Analysis of the Interrelationships of Musical Perception, Musical Response, and Differential Aptitudes

Abstract approved: Allan A. Fitzgerald

AN ANALYSIS OF THE INTERRELATIONSHIPS OF MUSICAL PERCEPTION, MUSICAL RESPONSE, AND DIFFERENTIAL APTITUDES

by

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An Abstract

Of a thesis submitted in partial fulfillment of the requirements
for the degree Master of Music in the School of
Liberal Arts and Sciences in the Graduate
School of Emporia State University

May 1977

Chairman: Dr. Vincent J. Bowman

ABSTRACT

Fisher, Robert Edward. "An Analysis of the Interrelationships of Musical Perception, Musical Response, and Differential Aptitudes." Unpublished Master of Music thesis, Emporia State University, 1977.

This study was concerned with specialized research in the development of musical learning theory. To better understand the nature of musical learning, an investigation was made into the interrelationships of musical perception, musical response and differential cognitive aptitudes.

The population sampling used consisted of the enrollments from two eighth-grade general music classes of Ottawa, Kansas, Junior-High School. A total number of sixty-six students participated, including twenty-nine boys and thirty-seven girls.

Twelve different measures were used in this investigation. These included three tests devised by the researcher to measure aspects of musical perception, one test devised by the researcher to measure musical response, and the eight sections of the Differential Aptitude Tests.

Multiple regression analysis was used to test the hypothesis. This statistical model was most appropriate due to the multi-dimensional nature of the problem. Because this complex model is subject to error in computations, a computer program was utilized for analysis of the data.

The findings show that certain cognitive aptitudes have a direct bearing upon musical learning. The only cognitive factor which seemed

to have a significant effect upon all the measured aspects of musical perception and musical response was the Verbal Reasoning/Numerical Ability Composite from the Differential Aptitude Tests. This indicated that general aptitude or intelligence has a direct bearing upon musical learning.

It was found that there was a marked difference in the factors that related to Chord-Tone Perception and the factors that related to the other musical measurements. The existence of two apparently exclusive sets of factors related to musical learning spawns the belief that at least two fundemental aptitudinal sets are in operation in musical learning: 1) Spatial Relations, Mechanical Reasoning, Clerical Speed and Accuracy, Spelling Ability; and 2) Verbal Reasoning, Numerical Ability, Abstract Reasoning, Sentence Structure (Syntax).

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A Thesis

Presented to

the Faculty of the Graduate School

Emporia State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Music

by

Robert E. Fisher

May 1977

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ACKNOWLEDGEMENTS

Appreciation is expressed to Dr. Vincent J. Bowman, Dr. Raymond Heath, and Dr. Kenneth Hart for their guidance and assistance. A special thanks is given to Mr. Albert Fitzgerrel who donated many hours for consultation, discussion, and advice while this study was in progress.

Much appreciation is also extended to Dr. Peter Ciurzcak, Chairperson of the Department of Music, and Dr. Vincent Bowman, Chairperson of the Department of Curriculum and Instruction for their help and cooperation in providing a joint committee through which this study was prepared.

Acknowledgement is due Dr. Dan Neuenswander, Superintendent of Schools, USD 290, and the Olathe Public Schools, without whose assistance this study would not have been possible.

In addition, appreciation is expressed to Dr. M. Lloyd Edwards and the Data Processing Center of Emporia Kansas State College for providing a multiple regression program and processing the data.

Finally, I wish to express my deep gratitude to my wife, Claudia, for her support, patience, and understanding while this study was in progress.

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Chapter 1

INTRODUCTION

This chapter is concerned with the nature of the learning process and its existence in musical experience. The need for a study into the interrelationships of musical preference, musical response, and differential aptitudes is discussed. The statements of the problem and the hypothesis, the significance and purpose of the study, definition of terms, and limitations of the study are also presented herein.

THEORETICAL FORMULATION

The nature of the learning process has interested man since the writings of Plato and Aristotle. Plato believed that the disciplined study of mathematics and philosophy was a necessary preparation for problem solving. Aristotle outlined several "natural faculties" of man. He believed that the greatest of all natural faculties was reason. Both based their theories on the belief that faculties for learning are inborn and are developed through mental discipline.

Empirical research in learning began around 1890 with the work of Ebbinghouse, Thorndike, and others. Thorndike disposed of the concept of inborn faculties by stating that the belief in the natural existence of attention, memory, reasoning and choice was "vanishing from the world of expert thought..."[1] Thorndike developed his own

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1. Edward L. Thorndike, Educational Psychology (New York: Teachers College, Columbia University, 1914), p. 73.

theory of learning known as connectionism. This concept is based on the formation of mental connections between stimuli and responses. It dominated American education for the first three decades of the twentieth century.[2]

The Gestalt doctrine, on the other hand, was introduced in the 1920's by Koffka and Köhler. A German term, Gestalt means a total configuration or a pattern. Gestalt theorists opposed the concept of learning through stimulus and response and developed new learning theories based on cognitive insight.[3]

These two philosophies of learning theory, connectionism and Gestalt, remained separate and were expanded with new theories developed by numerous psychologists. The emergence of this maze of new theories and nomenclatures prompted Hilgard to separate them into two classifications for better understanding. Association theories are concerned with observable reactions in experimentation. Associationists believe present behavior is a result of past experiences and that learning is responsible for behavior. Field theories place great importance on the whole of a concept in relation to its parts. Field theorists attribute more to the present field than to past experience. They explain behavior through native endowment rather than through learning.[4]

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2. Edward L. Thorndike, The Psychology of Learning: Educational Psychology, Vol. II (New York: Teachers College, Columbia University, 1913).

3. David P. Ausubel, Educational Psychology: A Cognitive View (New York: Holt, Rinehart and Winston, Inc., 1968), p. 286.

4. Ernest R. Hilgard, Theories of Learning (New York: Appleton-Century-Crofts, Inc., 1948), pp. 9-17.

More recently, learning theories have been developed by Piaget, Gagné, Ausubel, Skinner, and others. Although divergent views still exist, the theories suggest a comprehensive theory of learning. This continuing research has served to make educators aware of the implications of learning theory in teaching methods. It has also spawned the music educator's awareness of the lack of research in the area of musical learning theory. Music educators have utilized a few aspects of present learning theories (for example, motivation) in the classroom. Specialized musical learning theories, however, must be developed from specialized research. Leonard and House believe there is a definite need for "action research and experimental research pointed toward the development of a theory of musical learning and a technology of music teaching."[5]

There are two obvious factors which complicate efforts toward a specialized theory of musical learning. First, some musical learning is not easily observable. Second, comprehensive musical learning comes about through a variety of studies (for example, music history, music theory, sight-reading, etc.) which are different by the nature of the learning processes involved in each. An important step in the development of musical learning theory, then, would be an investigation into the possible interrelationships of the elements of musical learning.

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5. Charles Leonard and Robert W. House, Foundations and Principles of Music Education (New York: McGraw-Hill Book Co., 1972), p. 169.

THE PROBLEM

Musical learning is determined by the ability to perceive and respond to tonal-rhythmic structures and to utilize the various cognitive processes associated with a general measure of mental power. An assessment of musical perception, musical response, and differential aptitudes would supply measures of the processes described above. An investigation into the possible correlations of these measures would provide insight into the interrelationships of these processes.

Apparently no research to date has conclusively established possible interrelationships between perception and response to tonal-rhythmic structures and cognitive aptitudes. It is necessary that this approach be taken in order that further research toward a musical learning theory commence with a better idea of the nature of the processes involved.

Statement of the Problem

Is there a significant correlation between measures of musical perception, musical response, and differential aptitudes in the eighth-grade student?

Statement of the Hypothesis

There is no significant correlation between measures of musical perception, musical response, and differential aptitudes in the eighth-grade student.

Assumptions of the Study

The following assumptions were made in conducting this investigation.

1. The sample population tested was representative.

2. The Differential Aptitude Test scores were derived from a controlled test situation.

3. The subjects tested had normal auditory-sensory ability.

4. The subjects tested were familiar with tonal-rhythmic tendencies common to Western music and were therefore capable of developing musical expectations.

5. The subjects understood all instructions given.

Purpose of the Study

The purpose of this study was to correlate measures of musical perception, musical response, and differential aptitudes in order to establish interrelationships. The results and conclusions drawn should help to bring into focus connections between various cognitive aptitudes and musical learning elements so that further research in musical learning can begin with a point of reference.

Significance of the Study

In the past two decades relatively few studies into the phenomena of musical learning have been conducted. Of the studies that have been carried out, most have been concerned with attempts to apply cognitive learning theories to musical learning situations. Terms referring to visual processes have been re-defined and applied to the auditory senses. This may not be invalid, but it is questionable. Most approaches have dealt with only one or two aspects of musical learning. It is therefore appropriate that an overview be established to illustrate the types of cognitive learning that do apply to musical learning. It is further appropriate that musical response and musical perception be viewed separately to determine how each participates in the musical learning experience.

DEFINITION OF TERMS

Several key terms found in this thesis are listed below. Definitions of the terms are provided for clarity.

Affective Response

Affective response is a psycho-physiological response dealing with "feelings" or emotions. It is important to the development of values, attitudes, and preferences.

Aesthetic Experience

The aesthetic experience consists of attention to a phenomenon perceived as beautiful because of the combination of various basic elements, and a subsequent affective response to the beauty perceived.

Aptitude

Aptitude is one's potential for learning.

Cognitive

The cognitive ability deals with the recall or recognition of knowledge and the development of intellectual abilities such as abstract reasoning, mechanical reasoning, numerical relations, and others.

Learning

Learning is a process in which a problem progresses to a solution by apprehension, clarification, and application of meaning, and results in a change of behavior.

Musical Perception

Musical perception is a cognitive act by which meaning or information is gained from the auditory-sensory processes while a musical stimulus is present.

Musical Response

A musical response is an aesthetic response to a musical stimulus.

LIMITATIONS OF THE STUDY

Certain limiting factors influenced the outcome of findings and conclusions drawn. One uncontrollable variable was attention level of the subjects. Music psychologists agree that the perception of music depends upon the attention of the listener. If a musical stimulus is present but the subject is not attentive, no musical response will occur. Scores achieved on musical perception and musical response tests included in this study would be highly dependent upon the attention level of the subjects tested.

Peer consciousness is at an extremely high point in the eighth-grade student. In judgements as to preferences, a facial expression, a sigh, or a spoken comment can act to shift the true feelings of the student. For this reason, any outward expressions passed from one student to another in the course of this study would have served to invalidate the findings.

The population sampling was taken from only one school in order to impose a control on the effect of classroom instruction. However, this also limited the population for which the findings can be generalized.

Chapter 2

REVIEW OF RELATED LITERATURE

This chapter includes a review of literature found to be pertinent to an investigation of the interrelationships of musical perception, musical response, and differential aptitudes. Musical perception and musical response are discussed in terms of learning. The relevance of form and musical preference in this study is also discussed.

MUSICAL PERCEPTION

In the early twentieth century, American education was dominated by Thorndike's theory of connectionism and similar stimulus-response association theories of learning. These contributions to educational psychology permeated school systems, spawning new teaching methods in all subject areas.

It is not surprising that Carl Seashore's empirical studies of musical learning were strongly influenced by associationist theories. Basic to his research was the study of the responses of the ear to variations in the sound-wave.[1] He endorsed the associationist concept that perception depends on two separate acts. It occurs only through the sensing of stimuli and a subsequent response to selected stimuli. According to the associationist view, one is constantly receiving stimuli through the senses, but does not perceive until the mind has

1. Carl E. Seashore, Psychology of Music (New York: McGraw-Hill Book Company, Inc., 1938), pp. 2-5.

derived meaning from a stimulus or set of stimuli.[2] Binet describes the arrival of meaning as "the accompaniment of mental images which form the concept of a whole out of individual elements."[3] One may sense a sequence of musical tones, but not a melody. A melody is formed by the hearer from the raw tonal-rhythmic material he receives through his ears.[4]

The Seashore Measures of Musical Talents are constructed on the basis of a theory that musical aptitude consists of a number of separate sensory capacities including pitch, loudness, timbre, rhythm, rhythm-sequence and tonal-sequence discrimination. The pitch test contains fifty pairs of tones from which the student determines whether the second tone is higher or lower than the first. The loudness, timbre and rhythm tests also contain the same number and type of task. In the rhythm-sequence and tonal-sequence tests thirty pairs of patterns are given. Students are asked to respond to changes between the two examples in each pair. This emphasis on discrete sensory skills as a means toward musical learning illustrates the associationist concept of the sum of elements which creates a perceived whole.[5]

The validity of Seashore's test battery has been the topic of much debate. Seashore holds to the belief in internal consistency as a

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2. Morris L. Bigge and Maurice P. Hunt, Psychological Foundations of Education, second edition (New York: Harper & Row, Pub., 1968), p. 310.

3. Alfred Binet, The Psychology of Reasoning, second edition (Chicago: The Open Court Publishing Co., 1899), p. 8.

4. Max Schoen, The Psychology of Music (New York: The Ronald Press Co., 1940), p. 135.

5. Carl Seashore, et. al., The Seashore Measures of Musical Talents (New York: The Psychological Corporation, 1960).

basis for establishing validity.[6] However, Mursell questions the validity of Seashore's measures. He maintains that they should be validated against external criteria.[7] This position is supported by the weight of professional opinion.[8] Mursell concludes that excellent sensory aptitude is in itself no guarantee of musical excellence.[9]

Both Mursell and Gaston reject the associationist theory of perception. Gaston based his Test of Musicality upon the omnibus view of perceptual ability rather than the sensory ability of the individual.[10] Meyer supports this concept stating that musical stimuli are not simply directed to the senses, but through the senses and to the mind.[11] Mursell also proposes an omnibus or gestalt view of musical perception which is concerned with the totality as a functioning whole not deduced from its elements.[12] Langer concurs, seeing musical perception not as the ability to distinguish various elements but the recognition of the "commanding form" which creates an "inviolable

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6. Carl E. Seashore, "The Psychology of Music: XI," Music Educators Journal (December, 1937), pp. 25-26.

7. James L. Mursell, "What about Music Tests," Music Educators Journal (November, 1937), pp. 16-18.

8. Charles Leonard and Robert W. House, Foundations and Principles of Music Education (New York: McGraw-Hill Book Co., 1972), p. 400.

9. James L. Mursell, The Psychology of Music (New York: W. W. Norton & Co., Inc., 1937), p. 324.

10. E. Thayer Gaston, Test of Musicality: Manual of Directions (Lawrence, Kansas: Odell's Instrumental Service, 1957), p. 1.

11. Leonard B. Meyer, Music, the Arts and Ideas (Chicago: The University of Chicago Press, 1967), pp. 271-273.

12. Leon Crickmore, "The Musical Gestalt," Music Review, edited by Geoffrey Sharp, Vol. 33, No. 4 (1972), pp. 285-286.

whole."[13] To proponents of the gestalt view, the existence and recognition of form are basic. The mind's natural modes of pattern perception direct one's perception and understanding of the world.[14]

Seashore's work must not be totally rejected. Although the excellence of the ear as a receptor does not guarantee musical learning, the ear must receive or the mind cannot perceive. Moreover, sensory discrimination is vital to the perception of differences in the elements of music which are further enhanced by perception of the whole. On the other hand, the relevance of pattern recognition to musical learning is obvious, but a generalized gestalt account of musical perception is an over-simplification.[15] Maturation of the sensory nervous system depends upon both natural endowment and training. In addition, that which one experiences aurally early in life determines the course of musical perception.[16]

MUSICAL PERCEPTION AND LEARNING

The importance of musical perception lies in its relationship to learning. Although perception and learning are closely related, they are not the same process. Perception is a part of learning, and learning affects perception. Most importantly, perception results in

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13. Susanne K. Langer, Feeling and Form (New York: Charles Scribner's Sons, 1953), p. 147.

14. Meyer, op. cit., p. 273-274.

15. Leonard B. Meyer, Emotion and Meaning in Music (Chicago: The University of Chicago Press, 1956), p. 85.

16. Ronald Forgus, Perception (New York: McGraw-Hill Book Co., Inc., 1966), p. 143.

the development of concepts. Leonard defines concepts as "cognitive organizers of experience."[17] DeCecco supports this definition, describing a concept as "a class of stimuli which have common characteristics."[18] A concept is arrived at after several different experiences with similar stimuli.[19]

The development of musical concepts has been the subject of several studies. Pflederer made investigations into the Piagetian principle of conservation as it relates to musical learning. Conservation as defined by Piaget is a cognitive process whereby one perceives the invariance of a given factor throughout different stages. For example, a child who, when given equal amounts of water in different sizes of containers, is able to perceive the amounts of water as being equal, has succeeded at conservation of mass. The image of a circle shown at an angle may appear as an ellipse. Through conservation of shape, however, one perceives the image as a circle shown from a different angle or stage. Pflederer defined conservation in musical learning as the ability of an individual to perceive the non-varying quality of a musical stimulus inspite of changes in its structural presentation (deformation).[20]

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17. Charles Leonard and Robert W. House, Foundations and Principles of Music Education (New York: McGraw-Hill Book Co., 1972), p. 127.

18. John P. DeCecco, The Psychology of Learning and Instruction: Educational Psychology (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1968), p.388.

19. Charles R. Hoffer, Teaching Music in the Secondary Schools, second edition (Belmont, Calif.: Wadsworth Pub. Co., 1973), p. 186.

20. Marilyn Pflederer, "The Responses of Children to Musical Tasks Embodying Piaget's Principle of Conservation," Journal of Research in Music Education, ed. by R. Petzold, Vol. 12, No. 4 (1964), p. 254.

Pflederer devised six musical tasks for use in her study. These included conservation of meter, conservation of rhythm pattern under deformation of tone, conservation of melody under deformation of durational values, conservation of tonal pattern under deformation of pitch, conservation of tonal pattern under deformation of rhythm, and conservation of melody under deformation of accompaniment. The tasks were administered to eight kindergarten and eight third-grade students. She concluded that conservation does operate to some degree in musical learning.[21]

Botvin studied the acquisition of melodic conservation and cross-modal transfer through approximation. Basic melodic material was presented to the subjects. Through successive approximation, the same melodies were presented in extreme forms of augmentation and diminution. Subjects capable of perceiving the same melodic interval sequences were seen as having achieved conservation. Botvin concluded that transfer data strongly suggested that both musical and non-musical conservation are affected by the same cognitive processes. He deduced that this indicated a kinship between cognitive and musical development, and therefore new significance for the use of Piagetian developmental theory in music education.[22]

The relevance of Piagetian learning theory to musical learning is apparent. Cognitive processes operate in all forms of musical learning. The studies described above are significant in that they illus-

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21. Ibid., pp. 254-268.

22. Gilbert J. Botvin, "Acquiring Conservation of Melody and Cross-modal Transfer through Successive Approximation," Journal of Research in Music Education, Vol. 22, No. 3 (1974), pp. 226-233.

trate possibilities for application of Piagetian developmental theory to musical learning. Pflederer found significant differences in the conservation ability of the two groups tested. The third-grade students generally performed better on the conservation tasks than did the kindergarten students. Pflederer felt that this illustrated the existence of Piaget's concept of capacity attained through maturation. Botvin was able to increase to some degree the conservation abilities of his subjects. He believed this to be evidence that acceleration of the developmental process is possible. However, the limitations of his research lead one to question this deduction. Moreover, his findings have less relevance for the musical learning area than for other subject areas.

Larsen made an investigation that dealt with the application of a specific task of musical learning to Piaget's developmental stage theory. His subjects were randomly sampled from grade-levels three, five and seven. Subjects were asked to match pitch sequences with contours. Those who succeeded at this task were tested on recognition of previously perceived melodies treated in inversion, retrograde, and retrograde-inversion. Larsen found that age was a significant factor in succeeding at this task. He concluded that this illustrated a relevance for Piaget's concepts of developmental learning in music.[23]

Pirtle and Seaton studied the relationship of musical training to conceptual growth in the neurologically handicapped child. They

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23. Ronald L. Larsen, "Levels of Conceptual Development in Melodic Permutation Concepts Based on Piaget's Theory," Journal of Research in Music Education, Vol. 21, No. 3 (1973), pp. 256-263.

used higher and lower pitches to teach concepts of high and low, variations in dynamic level to teach concepts of loud and soft, and variations in tempo to teach concepts of fast and slow. Several other basic concepts were also taught. From the results of the study, Pirtle and Seaton concluded that music experiences aid the child in the development of other communication skills. The significance of this test lies not only in the direct connection between musical and cognitive concept learning, but also the association made between music and experience.[24] Leonard and Langer both recognize the function of music as a symbol of life-experience.[25]

Smith investigated the feasibility of tracking in teaching musical form. After testing seventh-grade level students he found that tracking aided in the perception of large musical forms and did not hamper the perception of smaller musical segments.[26] Smith's cognitive listening objective spawns a question. Is the educational objective that of aiding the student to perceive the immediate form, or to teach the student the method of tracking? This study holds significance for the development of a teaching method. However, there is question as to what was internalized and subsequently transferable in terms of learning.

In her review of research in elementary music education, Klem-

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24. Marilyn Pirtle and Kay P. Seaton, "Use of Music Training to Actuate Conceptual Growth in Neurologically Handicapped Children," Journal of Research in Music Education, Vol. 21, No. 4 (1973), pp. 292-310.

25. Leonard and House, op. cit., p. 95.

26. Alan Smith, "Feasibility of Tracking Musical Form as a Cognitive Listening Objective," Journal of Research in Music Education, Vol. 21, No. 3 (1973), pp. 200-213.

ish acknowledges that indications of true reversible thought in musical perception have been found at age seven. She notes that findings indicate a change from concrete to formal operations around the seventh-grade level. Both of these facts support Piagetian theory. In addition, most children have better concepts of loudness than of pitch. This situation probably stems from the fact that the concept of loudness is found in a number of experiences for the child, while the concept of pitch appears uniquely in musical situations.[27]

MUSICAL RESPONSE AND LEARNING

A study of musical learning and its relationship to only cognitive processes is invalid. Musical experiences are also strongly dependent upon the affective domain. Mursell states that one's musicality depends upon both the ability to perceive and to respond aesthetically to tonal-rhythmic design.[28] The aesthetic response described by Lundin is highly attentional, perceptual and affective.[29] All of these elements are interrelated. For example, cognitive awareness focuses attention and heightens affective response.[30]

Central to the existence of musical aesthetic response is musical meaning. There are two distinct schools of thought concerning

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27. Janice Klemish, "A Review of Recent Research in Elementary Music Education," Council for Research in Music Education, edited by Richard Colwell, et. al., No. 34 (Fall, 1973), pp. 23-40.

28. James L. Mursell, Education for Musical Growth (Boston: Ginn & Co., Inc., 1948), p. 6.

29. Robert W. Lundin, An Objective Psychology of Music, second edition (New York: Ronald Press Co., 1967), pp. 199-200.

30. Richard Colwell, The Evaluation of Music Teaching and Learning (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1970), p. 128.

the presence of meaning in music. The "isolationist" and "absolute formalist" believe musical meaning is inherent in the musical materials of a composition, and therefore not describable in non-musical terms. The "contextualist" and "referentialist" believe musical meaning is derived from a piece of music by an individual who has acquired a previously conditioned capacity for the reception of that particular meaning.[31] Farnsworth points out that absolutes have not been revealed by psychological research. "There is, for example, no absolutely good music, music whose goodness transcends time and space."[32] The facts indicate that there is a certain degree of meaning inherent in a musical piece. It is also evident that individuals vary with regard to sophistication of musical taste and the complexity of musical stimuli to which they respond. Musical meaning is derived from the existence of both absolute and referential meaning. Music based upon intellectually contrived devices contains expressive referential meaning.

Any meaning found in experience occurs through the interrelationship of the stimulus, the consequence, and the perceiver of the event. Types of meaning derived by the perceiver differ depending upon the relationship between the stimulus and the consequence. For instance, the stimulus "smoke" indicates the consequence "fire." Both elements are similar phenomena embodied in a perceived experience. The

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31. Abraham A. Schwadron, Aesthetics: Dimensions for Music Education (Washington, D. C.: Music Educators National Conference, 1967), pp. 35-36.

32. Paul R. Farnsworth, The Social Psychology of Music (Ames, Iowa: Iowa State University Press, 1969), p. 14.

type of meaning derived from a stimulus and consequence of the same kind of phenomena is embodied meaning. A word such as "fire" is a stimulus which designates a consequence we recognize as a natural phenomenon of the rapid oxidation of a substance, releasing heat and light. When the stimulus is not the same phenomenon as the consequence, and designates the consequence, the type of meaning derived is designative meaning.[33]

Designative meaning occurs in regard to music, but it is an extra-musical meaning. For example, music may be meaningful to a perceiver because it brings to mind a personal memory or image as a result of past experience. The "William Tell Overture" may spawn an image of "The Lone Ranger," but the phenomenon of music itself has no actual association with such an image. Because of its extra-musical character, designative meaning is rejected from discussions of the musico-aesthetic.

Embodied meaning, the musical meaning derived from a combination of perceived musical syntax and previous musical experiences of the individual, is the essential element in musical perception and musical learning. The embodied meaning of music is the meaning of life-experience. An individual responds to the import of music which is the pattern of sentience.[34] Time is filled with intellectual, emotional and physical tensions. One perceives the existence of actual time because he undergoes tensions and subsequent resolutions in life-experiences. Musical experiences are also composed of a tension- re-

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33. Meyer, Emotion and Meaning in Music, op. cit., p. 35.

34. Susanne K. Langer, Feeling and Form (New York: Charles Scribner's Sons, 1953), p. 31.

lease flow which give the illusion of the passage of time. Langer differentiates between actual time, that time sensed in life-experience, and virtual time, the passage of time sensed in a musical experience.[35]

Meyer goes further to explain the source of affective response in music. As life experiences are organized in thought and stored in memory, one develops expectations. Responses to the fulfillment of expectations become habit responses. However, when that fulfillment is blocked or delayed, a feeling response occurs and meaning is gained from the experience. A student attending class in the same classroom on a regular schedule develops insight into the basic structure of the room--its color scheme, arrangement of desks, etc. After learning this concept, expectations are developed. The student expects the classroom to appear "as always" according to his mental image, and upon entering the classroom he will experience habitual response, neutral meaning, and hence, no learning. If the student were to enter the classroom and find it painted a different color with desks placed in a new arrangement, the fulfillment of expectation would be blocked, and a feeling response would occur. The experience would include the derivation of meaning and would probably result in learning. From this learning new expectations would be developed.[36] In Bower's words, "The learning mechanism seems to become 'switched on' mainly when environmental events do not confirm expectations--when they are surpris-

35. Ibid., pp. 169-187.

36. Meyer, Music, the Arts, and Ideas, op. cit., pp. 8-9.

ing or informative."[37]

Meyer sees the same process occurring in music. This is due to its symbolism of life-experience. A tonal-rhythmic pattern which proceeds in the expected manner is neutral with regard to meaning. When the expected consequence is delayed or blocked musical meaning occurs. According to Meyer, three varieties of deviation from expectation exist: 1) the probable event may be delayed temporarily by hesitation or use of a less direct route; 2) the probable event may be ambiguous, with alternatives carrying equal probability; 3) the consequent event may be unexpected.[38]

Both thought and memory are the foundations for the development of expectations. One listens to a particular musical work, organizing experiences and developing expectations. This occurs both in terms of what has previously been heard in that piece and memories of pertinent musical experiences from the past.[39] Moreover, an individual's knowledge and resultant expectations influence his perception.[40]

Birkhoff worked diligently to provide a basis for an "aesthetic measure" of music, concerning himself with diatonic harmony and melody. His measures are dependent upon his criteria for measurement and expectation. He even assigns an aesthetic measure to a single chord. This careful and systematic approach does not relate in any way to tension-release flow, except for a measure of consonance and dissonance.

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37. Gordon H. Bower, "Cognitive Psychology: An Introduction," Handbook of Learning and Cognitive Processes, Vol. 1, edited by W. K. Estes (Hillsdale, N. J.: Lawrence Erlbaum Assoc., 1975), p. 71.

38. Meyer, Music, the Arts, and Ideas, pp. 9-10.

39. Meyer, Emotion and Meaning in Music, pp. 87-88. 40. Ibid., p. 77.

Fulfillment of expectation, rather than delay of expectation, is the principle upon which much of his aesthetic measure is based. The consonance-dissonance section relates to the expected resolution. Since there is strong evidence that an investigation into musical response must incorporate the essential elements of tension-release flow and delayed expectation, Birkhoff's analysis is extremely weak. Birkhoff's work is significant, however, in its attempt to establish a theory of musical aesthetics.[41]

FORM AND LEARNING

Form is vital to musical perception and learning. It clarifies the organization of time as it exists in all aspects of life-experience.[42] Bruner notes that when structure is attained, knowledge is more easily transferred.[43] Moreover, memory span is greater for music from which meaning is derived than for completely unrelated tones. In fact, as the tonal-rhythmic design becomes more complex, memory span decreases.[44] This leads one to conclude that any study testing the perception of, and memory for, tonal-rhythmic stimuli must utilize meaningful musical examples. For example, the tonal sequence section of Seashore's test battery does not contain meaningful musical examples and may therefore be invalid. Conversely, the meaningful musical

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41. George Birkhoff, Aesthetic Measure (Cambridge: Harvard University Press, 1933).

42. John Dewey, Art as Experience (New York: Minton, Balch & Co., 1934), p. 24.

43. Jerome Bruner, The Process of Education (Cambridge: Harvard University Press, 1965), p. 17.

44. Lundin, op. cit., p. 129.

examples used in Gaston's Test of Musicality are probably valid test items.

STUDIES IN MUSICAL PERCEPTION/RESPONSE SETS

One product of musical learning relevant to this discussion is musical preference or taste. Musical preference results from the liking of a particular musical style, piece, or arrangement due to the perception of, and affective response to, that style, piece, or arrangement. Factors which determine musical preferences are early childhood musical experiences and the development of expectations due to past and present musical experiences.[45] Although musical preference is an actual set of perceptions and responses, its significance lies in how it relates to other processes. Several studies have incorporated musical preference as a variable. Mayeske investigated the relationship between musical preference and dimensions of personality. He concluded that musical preference was found to be a stable phenomenon over the testing period (one and one-half days) and unaffected by the time of day.[46]

A study to determine relationships between musical experience and musical taste, and mental ability and musical taste, was conducted by Erneston. The findings suggest that there is a strong relationship between musical experience and acquired musical taste. No evidence was discovered, however, linking any particular type of musical

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45. Charles Hughes, The Human Side of Music (New York: Philosophical Library, Inc., 1948), p. 29.

46. George Mayeske, "Some Associations of Musical Preference Dimensions of Personality" (unpublished dissertation, Illinois University, 1962).

activity with a more sophisticated level of musical taste. Erneston also found that mental ability was a highly significant factor in the development of tastes in persons experienced in music, but not significant among musically inexperienced persons.[47]

Gerren correlated intelligence, musicality and musical preference. Gaston's Test of Musicality was used for an assessment of musicality. Gerren found a significant correlation between intelligence and musicality (0.590), and between intelligence and sophistication of musical preference (0.430).[48]

A correlational study of aesthetic sensitivity, musicality (Gaston), intelligence and socioeconomic status was conducted by Parker. The highest significant correlation (0.420) was found in the relationship between aesthetic sensitivity and musicality in girls with intelligence and socioeconomic status held constant. In the same category, the correlation for boys was 0.296 and for both girls and boys was 0.391. He concluded that this represented a "moderate relationship" between aesthetic sensitivity and musicality.[49]

Washburn tested the effects of repetition and familiarity on preference response. He found that repetition and familiarity tended to lower response to popular music after a short period of time.

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47. Nicholas Erneston, "A Study to Determine the Effect of Musical Experience and Mental Ability on the Formulation of Musical Taste" (unpublished dissertation, Florida State University, 1961).

48. N. L. Gerren, "A Study of the Relationship between Intelligence, Musicality, and Attitude toward Music" (unpublished dissertation, University of Kansas, 1953).

49. Olin Parker, "A Study of the Relationship of Aesthetic Sensitivity to Musical Ability, Intelligence, and Socioeconomic Status" (unpublished dissertation, University of Kansas, 1961).

However, the same process had an opposite effect on the response to serious-classical music.[50]

Certain conclusions can be drawn from these studies. First, a pre-established capacity or conditioning for perception of, and response to musical forms acts as a point of reference in musical learning. Second, repetition and familiarity enable one to learn and develop expectations concerning musical stimuli. Third, after learning of the musical piece has occurred, expectations become latent and response habitual. No new meaning is gained and interest is lessened. Fourth, the more complex the example, the more likely it will offer additional meaning upon several repetitions. Fifth, an ability to perceive greater complexity in tonal-rhythmic design depends to some extent on intelligence. However, intelligence alone does not guarantee musical perception excellence. The individual must also have encountered a number of musical experiences.

DIFFERENTIAL APTITUDE

No studies were found which relate musical perception, musical response, and differential aptitude. The use of the Differential Aptitude Test (DAT) is significant because it avoids reliability problems caused by I.Q. tests. In the past, parents, teachers and students believed an I.Q. was an appraisal of overall learning potential. However, research has shown that such potential is really a composite of various learning aptitudes. The DAT tests eight aptitudes: Verbal Reasoning,

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50. M. F. Washburn, et. al., "The Effects of Immediate Repetition on the Pleasantness or Unpleasantness of Music," The Effects of Music, edited by Max Schoen (New York: Harcourt, Brace & World, Inc., 1927).

Numerical Ability, Abstract Reasoning, Spatial Relations, Mechanical Reasoning, Clerical Speed and Accuracy, Spelling, and Sentence Structure (syntax).[51]

The DAT was first published in 1947 by the Psychological Corporation. Last revised in 1972, the DAT is more widely used on the secondary school level than any other multiaptitude test. Two of the most important guiding principles in the development of the DAT were that it should measure multiple abilities and that it should be useful in educational and vocational guidance.[52]

Developed primarily for school programs, the DAT represents a collection of reasonably independent measures which cover extensively those aspects most directly related to school achievement. Intertest correlations range from 0.06 to 0.67. On the average the intercorrelations are approximately 0.50. It is usually desirable to have lower correlations. However, they are low enough for the test battery to function as a measure of differential aptitudes.[53]

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51. Norman E. Gronlund, editor, <u>Readings in Measurement of Evaluation</u> (New York: The MacMillan Company, 1968), p. 297.

52. Fredrick G. Brown, <u>Principles of Educational and Psychological Testing</u>, second edition (New York: Holt, Rinehart and Winston, 1976), p. 327.

53. Jum C. Nunnally, <u>Educational Measurement and Evaluation</u>, second edition (New York: McGraw-Hill Book Co., 1972), p. 329.

Chapter 3

METHODS AND PROCEDURES

This chapter contains an explanation of the population and sampling procedures used in this study. A description of materials and instrumentation, and the statistical design of the study are also included.

POPULATION AND SAMPLING

The population sampling used in this study consisted of the enrollments from two eighth-grade general music classes of Ottawa, Kansas, Junior-High School. A total number of sixty-six students participated, including twenty-nine boys and thirty-seven girls.

MATERIALS AND INSTRUMENTATION

Twelve different measures were utilized in this study. These included three tests devised by the researcher to measure aspects of musical perception, one test devised by the researcher to measure musical response, and the eight tests of the DAT to measure differential aptitudes.

One test of musical perception, Chord-Tone Perception (CTP), is composed of twenty musical examples. For each example a tone was sounded, followed by a chord. The students were asked to respond to whether they perceived the tone as an element of the chord. Since musical experiences in context may vary greatly in harmonic complexity, the chord examples in the CTP test also varied greatly in complexity.

Each chord was assigned a "difficulty rating" based on the various adjacent intervals which combined to make the chord. Intervals of a major-third, minor-third, perfect-fourth, perfect-fifth, minor-sixth, and major-sixth were each rated at a difficulty level of 1.0. Intervals of a major-second were assigned a difficulty rating of 2.0, and minor-second intervals were assigned a difficulty rating of 3.0. No tritones were included as adjacent intervals in any of the examples. Chord difficulty ratings ranged from 1.0 to 15.0.

A second test of musical perception, Tonal-Rhythmic Memory (TRM), includes ten examples. For each example, the students were asked to listen carefully as a melody was played. They were instructed to try to remember the melody verbatim. The melody was then repeated several times. The students were asked to respond to whether they detected a pitch or rhythm alteration in the repeated melody. They were also requested to note when they perceived no change from the original melody.

The Tonal-Rhythmic Contour Perception test (TRCP), a third test of musical perception, consists of ten examples. A melodic example was sounded as the students studied two linear contour drawings. After having listened to the example, the students circled the linear contour that each believed best represented the tonal-rhythmic design of the example.

The Musical Response Test (MRT), consists of twenty pairs of musical examples. The students were asked to listen to a pair of examples and then indicate which of the two they preferred. In each pair, the example composed from trite or expected progressions was considered to be less aesthetic than the example conceived from the delay-of-expectation principle. Expectation was delayed either melodically, harmonically, rhythmically, dynamically, or through some combination of these.

All of the musical examples for the tests of musical perception and musical response were recorded on a magnetic tape for convenience during the administration of the tests. The piano was the performance medium used for all examples on all of the tests.

Since each test was constructed on the basis of defined criteria discussed in this text, the tests have content validity. The reliability coefficient of each test was computed by using the split-half method. A correlation coefficient was derived for a half-test by using the following formula:

$$r_{oe} = \frac{\Sigma X_o X_e / N - (\bar{X}_o)(\bar{X}_e)}{(s_o)(s_e)}$$

where: X_o = scores on odd-numbered items

X_e = scores on even-numbered items

N = number of subjects

$\bar{X}_o$ = mean of scores (odd)

$\bar{X}_e$ = mean of scores (even)

s_o = standard deviation of scores (odd)

s_e = standard deviation of scores (even)

After computing the reliability of the half-test, the reliability of the original test was calculated by using the Spearman-Brown formula:

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1. Frederick G. Brown, Principles of Educational and Psychological Testing, second edition (New York: Holt, Rinehart and Winston, 1976), p. 74.

$$r_{xx}=\frac{2r_{oe}}{1+r_{oe}}$$

where: r_{xx}= reliability of the original test

r_{oe}= reliability of the half-test[2]

The following reliability coefficients were computed: Chord-Tone Perception, r_{oe}=0.67 and r_{xx}=0.80; Tonal-Rhythmic Memory, r_{oe}=0.71 and r_{xx}=0.83; Tonal-Rhythmic Contour Perception, r_{oe}=0.64 and r_{xx}=0.78; Musical Response Test, r_{oe}=0.77 and r_{xx}=0.87. All four tests were found to have high or moderately high reliability coefficients, and were therefore considered to be reliable measures in a group study.[3]

The Differential Aptitude Tests are eight separately administered tests. The first test, Verbal Reasoning (VR), is more concerned with reasoning than with verbal comprehension. The test items consist of verbal analogies utilizing low-difficulty vocabulary. The test of Numerical Ability (NA) was constructed to determine computational ability. The Abstract Reasoning (AR) test deals with the ability to derive logical deductions from abstract patterns. The fourth test, Spatial Relations (SR), is concerned with the visualizing of three-dimensional objects from two-dimensional patterns and the conserving of shape in objects rotated in space. The test of Mechanical Reasoning (MR) includes illustrations which portray mechanical problems about which the student is asked questions. The only test in the DAT that is not a power test is the measure of Clerical Speed and Accuracy (CSA). This test deals with the rapid perception and recognition of identical sets.

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2. Ibid., p. 75.

3. Richard Colwell, The Evaluation of Music Teaching and Learning (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1970), p. 37.

The final two tests are both classified under Language Usage. The first is designed to measure Spelling Ability (SA), and the second measures the student's understanding of Sentence Structure (SS), or syntax.[4]

Scores for each of the eight tests are provided in the form of percentiles. A composite score for Verbal Reasoning and Numerical Ability (V/N) is also included. This score is generally interpreted as a broad scholastic aptitude quotient similar in function to the I.Q.[5]

The split-half reliability method was utilized to compute coefficients of internal consistency for all of the tests, except the CSA test (primarily a speed test requiring an alternate reliability computation method). Mean reliability coefficients range from 0.87 to 0.94 for boys and from 0.79 to 0.95 for girls, indicating highly satisfactory reliability for group measurement and individual measurement.[6]

Validity data for the DAT are plentiful. Most of the data are based upon the predictability of course grades. Other validity data were derived from correlations with achievement tests. Some data are based upon post-high school education and/or occupations. The validity coefficients are sufficiently high to establish the validity of the DAT.[7]

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4. Jum C. Nunnally, Educational Measurement and Evaluation, second edition (New York: McGraw-Hill Book Co., 1972), pp. 326-329.

5. Anne Anastasi, Psychological Testing, third edition (New York: MacMillan Publishing Co., Inc., 1968), p. 340.

6. Colwell, op. cit., p. 37.

7. George K. Bennet, Harold G. Seashore, and Alexander G. Wesman, Manual for the Differential Aptitude Tests, fourth edition (New York: The Psychological Corporation, 1963), pp. 1-28.

The DAT was administered to the eighth-grade class of Ottawa, Kansas Junior-High School by school officials in the Fall, 1976. The tests for musical perception and musical response were administered to the sample population in January, 1977. The total amount of time allowed for the administration of the music tests was one hour.

At the beginning of the period, the students entered the room and were handed three sheets of paper which were stapled together. The first page provided spaces at the top for an identification number (for collection of anonymous data) and the student's name (used only by the counselor to locate the proper DAT scores). The rest of the page contained information and basic instructions. The other two pages were test answer sheets. (See Appendix A)

Prior to testing, the students were told that the results of the tests would not have any effect on their grades. The students were also told that they had been selected for the study. This seemed to connote honor to them, thereby helping to establish a positive attitude toward the study. The importance of total silence without any outward expressions was stressed prior to testing and preceding each test. This approach was taken in order to lower the effect of peer-consciousness in the students. Administration time for each test was as follows: CTP test, eleven minutes; TRM test, twenty minutes; TRCP test, nine minutes; and MRT test, thirteen minutes.

DESIGN OF THE STUDY

Multiple regression analysis was used to test the hypothesis. This statistical model was most appropriate due to the multi-dimensional nature of the problem. The behaviors that were observed were musical perception, musical response and differential aptitudes. The degree to which these behaviors are interrelated was the focus of this study.

The principal uses of multiple regression are: 1) the construction of a model of the independent variables (X) that gives the best prediction of the values of the criterion variable (Y); 2) the discovery of the subset of X's that provides the best prediction of Y; and 3) the discovery of variables that are related to Y.[8] Each case is accomplished through the regression of Y on several independent variables. This regression model takes the following form:

$$Y = a + b_1(X_1-\overline{X}_1) + b_2(X_2-\overline{X}_2) + \ldots + b_k(X_k-\overline{X}_k)$$

where: Y = the criterion variable

a = a computed constant

$\overline{X}$ = the sample mean

Letting $x_i = X_i-\overline{X}_i$ yields the equation:

$$Y = a + b_1x_1 + b_2x_2 + \ldots + b_kx_k$$ [9]

The <u>standard error of estimate</u> is a statistic which has the same relation to the regression line in a scatter diagram as the standard deviation has to the arithmetic mean. An equation for the standard error of estimate (S) can be derived from the regression equation and takes the form:

$$S^2 = \frac{\Sigma Y^2 - a\Sigma Y - b_1\Sigma Yx_1 - b_2\Sigma Yx_2 - \ldots - b_k\Sigma Yx_k}{n}$$

The standard error of estimate measures the closeness of agree-

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8. George W. Snedecor and William Cochran, <u>Statistical Methods</u>, sixth edition (Ames, Ia.: Iowa State University Press, 1967), p.381.

9. Olive J. Dunn and Virginia A. Clark, <u>Applied Statistics: Analysis of Variance and Regression</u> (New York: John Wiley & Sons, 1974), 252.

ment between the estimated values and the original values. However, it does not measure the proportion of the criterion variance that is accounted for by the predictor variables. For this, multiple regression analysis depends upon the computation of a coefficient of determination (R^2) which is actually the square of the multiple correlation coefficient (R) found between the independent variables and the criterion measure. In terms of standard error of estimate, the coefficient of determination is computed as follows:

$$R^2 = 1 - \frac{S^2}{s^2}$$

where: S = standard error of estimate

s^2 = sample variance[10]

The coefficient of determination is interpreted as the proportion of variation in the criterion measure which is associated with, or can be predicted by, variation in the independent variables. The value of R^2 ranges from 0.0 with no relationship, to 1.0 with a perfect relationship.

In this study, coefficients of determination were computed with each variable designated as the criterion measure. This established the relationship existing between each full model (FM) and criterion measure. Restricted models (RM) were then formed by the deletion of individual variables from the full models. The R^2 for each restricted model was also computed. The significance of difference between the full model R^2 and restricted model R^2 was shown by the F-statistic which was computed by the following equation:

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10. Samuel B. Richmond, Statistical Analysis, second edition (New York: The Ronald Press Company, 1964), pp. 456-457.

$$F = \frac{(R_f^2 - R_r^2)/(m_1 - m_2)}{(1 - R_f^2)/(N - m_1)}$$

where: R_f^2 = coefficient of determination for full model

R_r^2 = coefficient of determination for restricted model

m_1 = number of weights associated with the number of linearly independent vectors in the full model

m_2 = number of weights associated with the number of linearly independent vectors in the restricted model[11]

The F-test is an analysis of variance. It is a ratio of the observed variance of treatment means to the expected chance variance of these means within the proper degrees of freedom. An F-table provides the critical F-values within various degrees of freedom at both the 0.05 and 0.01 levels of confidence. If an F-value is found to be less than the critical value, this means that the variance occurring among the sample means can be attributed to the variance within the samples. That is, any existing interrelationships would have been produced by the same random or chance forces. However, an F-value that is greater than the critical value is considered to be significant and indicates that the observed variance among the sample means can not be accounted for by the variance within the samples.

Sample means naturally differ by chance variation. For this reason, F-values that were computed in this study were compared with critical values at the 0.01 level of confidence. This decreased the probability of a Type I error (rejection of a true hypothesis), but also increased the probability of a Type II error (acceptance of a

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11. Francis J. Kelly, et. al., Multiple Regression Approach (Carbondale and Edwardsville, Ill.: Southern Illinois University Press, 1969), p. 139.

false hypothesis).[12]

DATA COLLECTION

The DAT scores used in this study were collected anonymously through the use of identification numbers for the students tested. The school counselor was provided with a sheet of paper for the recording of the DAT scores. An ID number corresponded to each line of scores. An overlay was attached to the scoring sheet. It provided the names of students corresponding to proper ID numbers. After all DAT scores were recorded by the counselor, the overlay was detached. The recorded scores were then returned to the researcher with only the corresponding ID numbers. This method of score collection was efficient and met with federal standards of privacy.

All of the tests for musical perception and musical response were scored simply by recording the number of correct responses. Only the Chord-Tone Perception test had a second score. The CTP was also scored according to the sum of chord difficulty ratings for all correct responses. Both sets of scores were used in the multiple regression analysis.

DATA ANALYSIS

The multiple regression model is extremely complex and often results in human error in computations of various statistics. For this reason, a computer program was utilized for analysis of the data.

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12. Richmond, op. cit., pp. 308-309.

Chapter 4

ANALYSIS OF DATA

The hypothesis for this study was tested by the analysis of raw data (Appendix B) that were collected from the tests of musical perception (CTP, TRM, TRCP), musical response (MRT), and differential aptitudes (VR, NA, AR, SR, MR, CSA, SA, SS). With the additional score from the CTP test and the composite V/N score from the DAT, the total number of scores given for each student was fourteen.

RESPONSE ANALYSIS

As described in Chapter 3, the total number of students tested was sixty-six, including twenty-nine boys and thirty-seven girls. All musical perception and musical response test items were answered in full. No test scores had to be deleted from the study due to apparent inattentiveness or outward expressions by students during the testing period. A complete set of DAT scores for each student was reported by the school counselor.

STATISTICAL ANALYSIS

In order to test completely the hypothesis of this study, fourteen multiple regression models were constructed. These were composed of fourteen full models ($FM_a \ldots FM_n$) and one-hundred eighty-two restricted models, thirteen for each full model ($RM_{a1} \ldots RM_{a13}$, $RM_{b1} \ldots RM_{b13}$, . . . , $RM_{n1} \ldots RM_{n13}$). Each restricted model was formed by the omission of each variable from every full model. (See Table 1 and

Charts 1 through 14) The relation of various restricted models to full model criteria was as follows:

Chord-Tone Perception (based on the number of correct responses) was omitted from full models $FM_b \ldots FM_n$ to form restricted models $RM_{b1} \ldots RM_{n1}$. This determined the effect of Chord-Tone Perception upon each criterion measure.

Chord-Tone Perception (based on the sum of chord difficulty ratings) was omitted from full models FM_a, $FM_c \ldots FM_n$ to form restricted models RM_{a1}, $RM_{c2} \ldots RM_{n2}$. This determined the effect of Chord-Tone Perception based upon difficulty level upon each criterion measure.

Tonal-Rhythmic Memory was omitted from full models FM_a, FM_b, $FM_d \ldots FM_n$ to form restricted models RM_{a2}, RM_{b2}, $RM_{d3} \ldots RM_{n3}$. This determined the effect of Tonal-Rhythmic Memory upon each criterion measure.

Tonal-Rhythmic Contour Perception was omitted from full models $FM_a \ldots FM_c$, $FM_e \ldots FM_n$ to form restricted models $RM_{a3} \ldots RM_{c3}$, $RM_{e4} \ldots RM_{n4}$. This determined the effect of Tonal-Rhythmic Contour Perception upon each criterion measure.

Musical Response was omitted from full models $FM_a \ldots FM_d$, $FM_f \ldots FM_n$ to form restricted models $RM_{a4} \ldots RM_{d4}$, $RM_{f5} \ldots RM_{n5}$. This determined the effect of Musical Response upon each criterion measure.

Verbal Reasoning was omitted from full models $FM_a \ldots FM_e$, $FM_g \ldots FM_n$ to form restricted models $RM_{a5} \ldots RM_{e5}$, $RM_{g6} \ldots RM_{n6}$. This determined the effect of Verbal Reasoning upon each criterion measure.

Numerical Ability was omitted from full models $FM_a \ldots FM_f$, $FM_h \ldots FM_n$ to form restricted models $RM_{a6} \ldots RM_{f6}$, $RM_{h7} \ldots RM_{n7}$. This determined the effect of Numerical Ability upon each criterion measure.

The composite Verbal Reasoning/Numerical Ability score was omitted from full models $FM_a \ldots FM_g$, $FM_i \ldots FM_n$ to form restricted models $RM_{a7} \ldots RM_{g7}$, $RM_{i8} \ldots RM_{n8}$. This determined the effect of the composite aptitude upon each criterion measure.

Abstract Reasoning was omitted from full models $FM_a \ldots FM_h$, $FM_j \ldots FM_n$ to form restricted models $RM_{a8} \ldots RM_{h8}$, $RM_{j9} \ldots RM_{n9}$. This determined the effect of Abstract Reasoning upon each criterion measure.

Spatial Relations was omitted from full models $FM_a \ldots FM_i$, $FM_k \ldots FM_n$ to form restricted models $RM_{a9} \ldots RM_{i9}$, $RM_{k10} \ldots RM_{n10}$. This determined the effect of Spatial Relations upon each criterion measure.

Mechanical Reasoning was omitted from full models $FM_a \ldots FM_j$, $FM_l \ldots FM_n$ to form restricted models $RM_{a10} \ldots RM_{j10}$, $RM_{l11} \ldots RM_{n11}$. This determined the effect of Mechanical Reasoning upon each criterion measure.

Clerical Speed and Accuracy was omitted from full models $FM_a \ldots FM_k$, FM_m, FM_n to form restricted models $RM_{a11} \ldots RM_{k11}$, RM_{m12}, RM_{n12}. This determined the effect of Clerical Speed and Accuracy upon each criterion measure.

Spelling Ability was omitted from full models $FM_a \ldots FM_l$, FM_n to form restricted models $RM_{a12} \ldots RM_{l12}$, RM_{n13}. This determined the effect of Spelling Ability upon each criterion measure.

Syntax Ability (Sentence Structure) was omitted from full models $FM_a \ldots FM_m$ to form restricted models $RM_{a13} \ldots RM_{m13}$. This determined the effect of Syntax Ability upon each criterion measure.

Table 1

List of Variables

Number	Variable	Designation
1	Chord-Tone Perception (frequency of correct responses)	X_1
2	Chord-Tone Perception (sum of chord difficulty rating)	X_2
3	Tonal-Rhythmic Memory	X_3
4	Tonal-Rhythmic Contour Perception	X_4
5	Musical Response	X_5
6	Verbal Reasoning	X_6
7	Numerical Ability	X_7
8	Numerical Ability/Verbal Reasoning Composite	X_8
9	Abstract Reasoning	X_9
10	Spatial Relations	X_{10}
11	Mechanical Reasoning	X_{11}
12	Clerical Speed and Accuracy	X_{12}
13	Spelling Ability (Language Usage I)	X_{13}
14	Sentence Structure (Syntax Ability--Language Usage II)	X_{14}

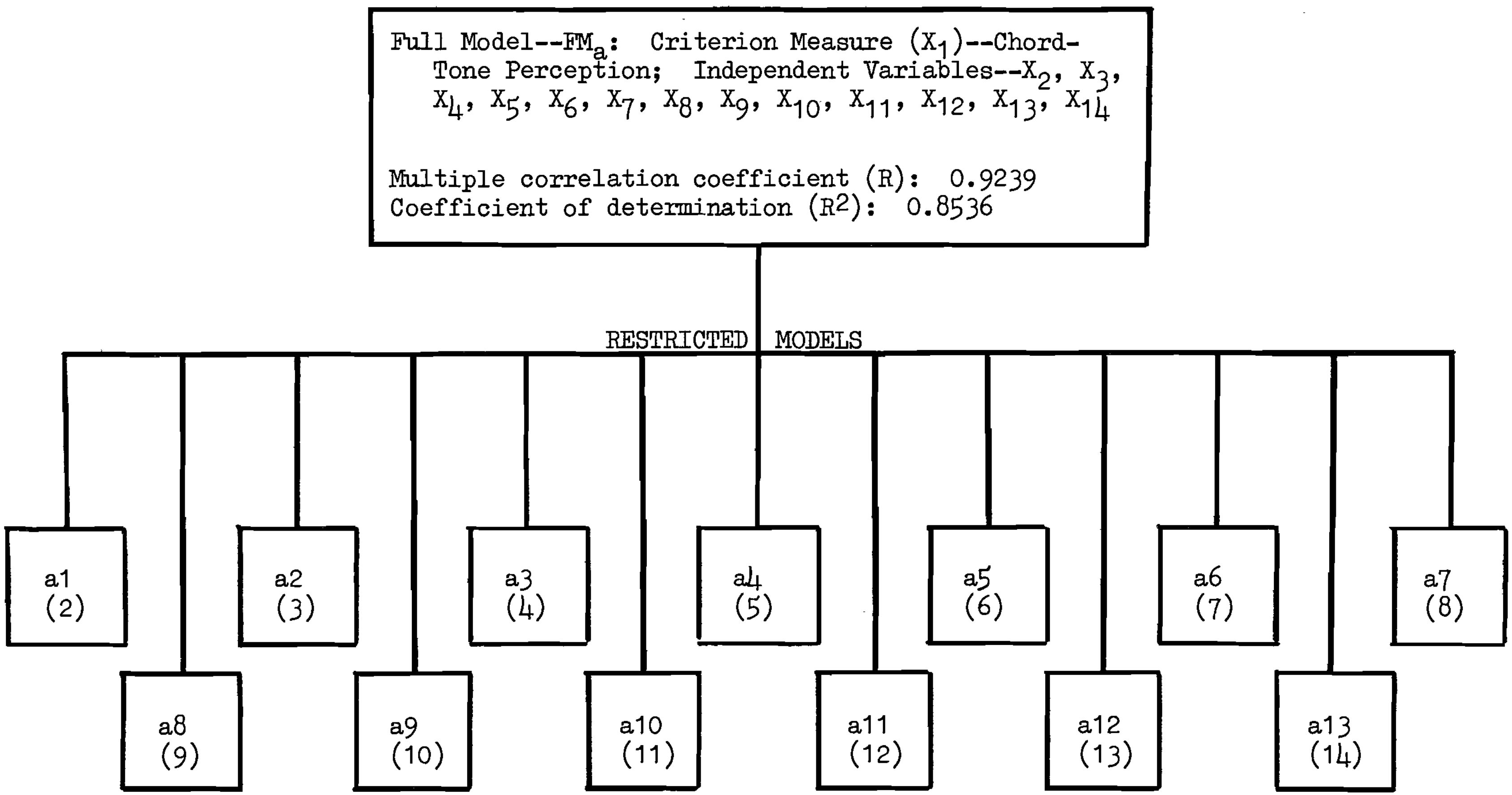

Chart 1. Multiple regression models with Chord-Tone Perception as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

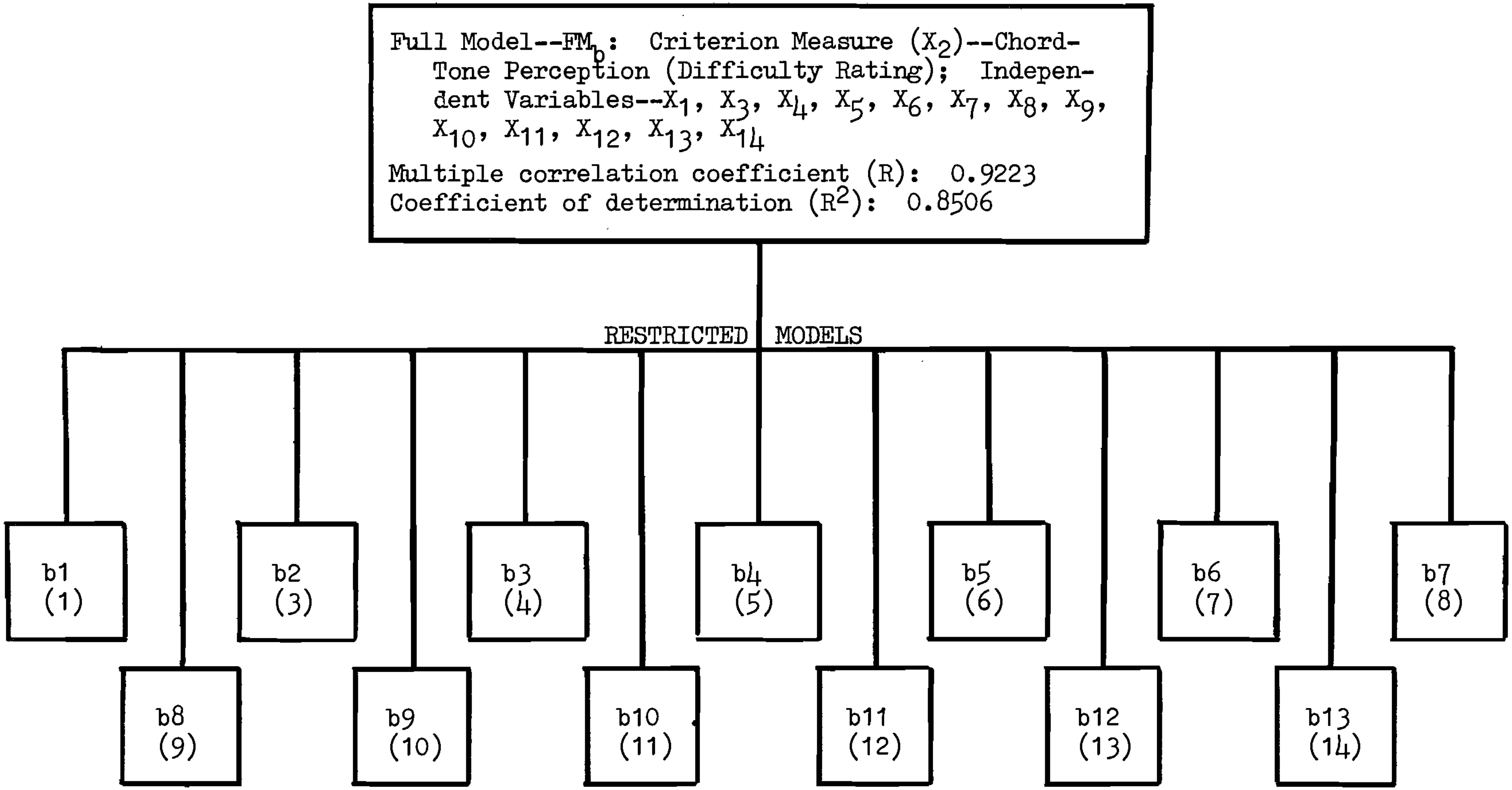

Chart 2. Multiple regression models with Chord-Tone Perception (Difficulty Rating) as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

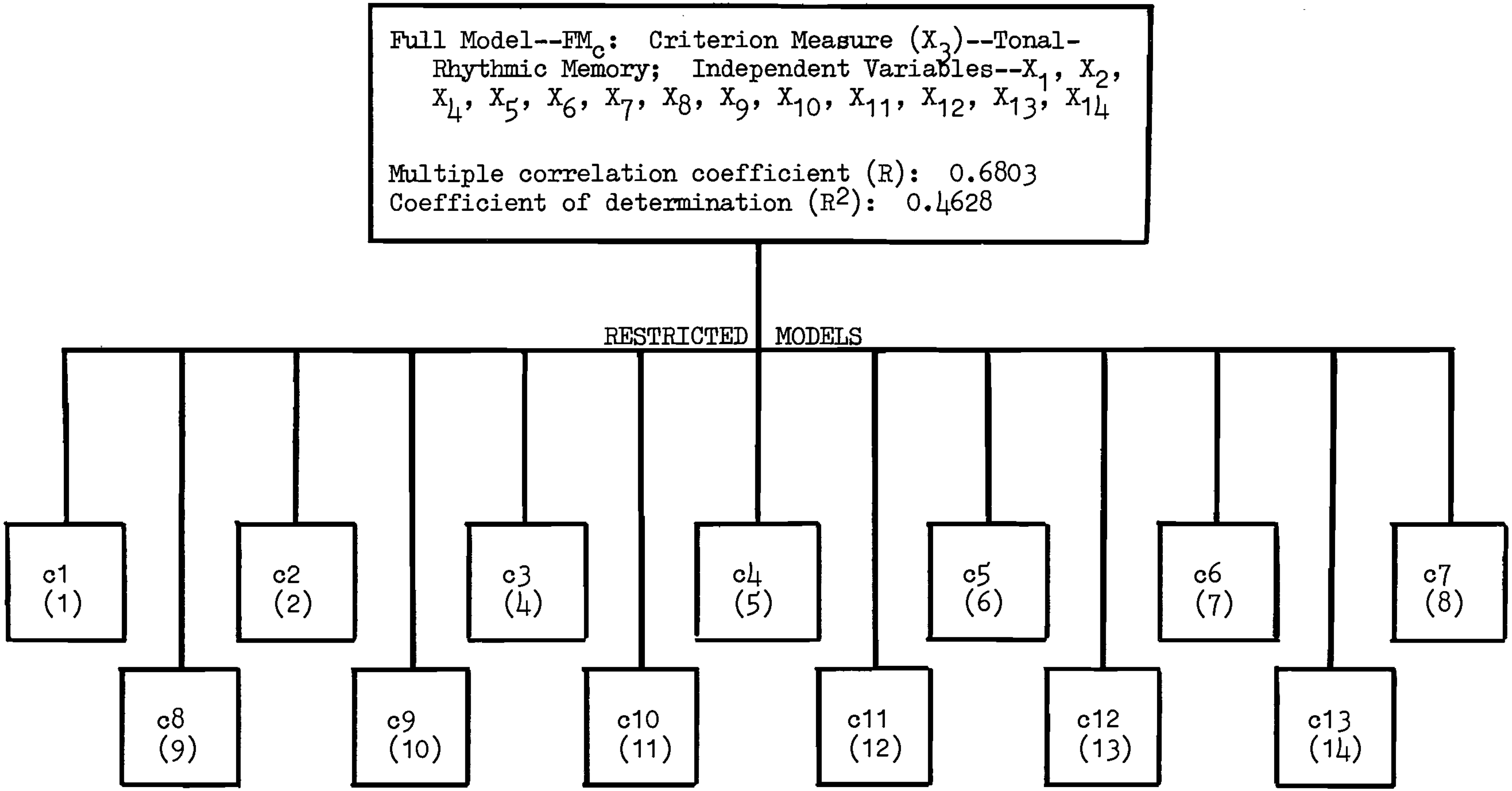

Chart 3. Multiple regression models with Tonal-Rhythmic Memory as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

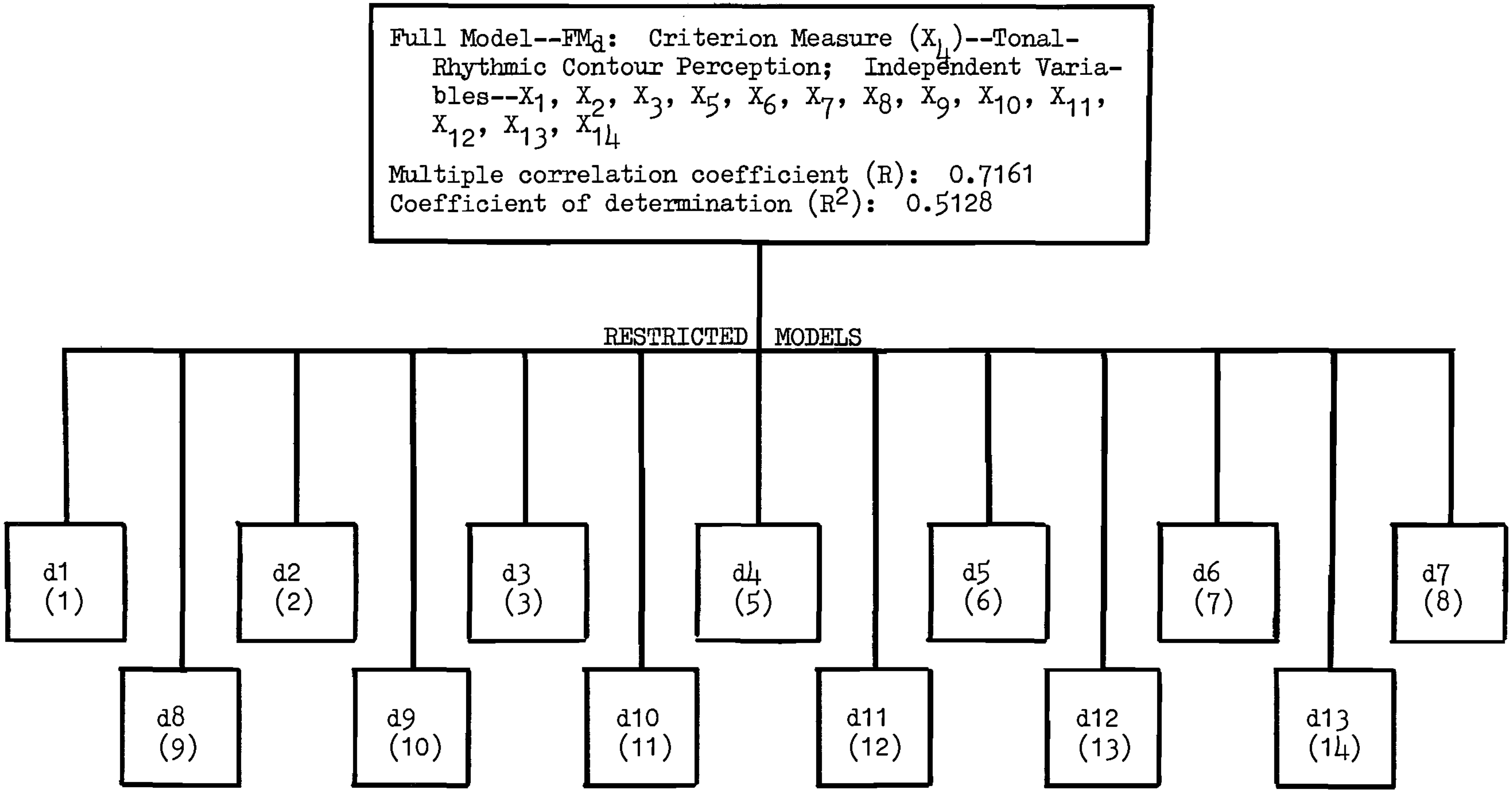

Chart 4. Multiple regression models with Tonal-Rhythmic Contour Perception as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

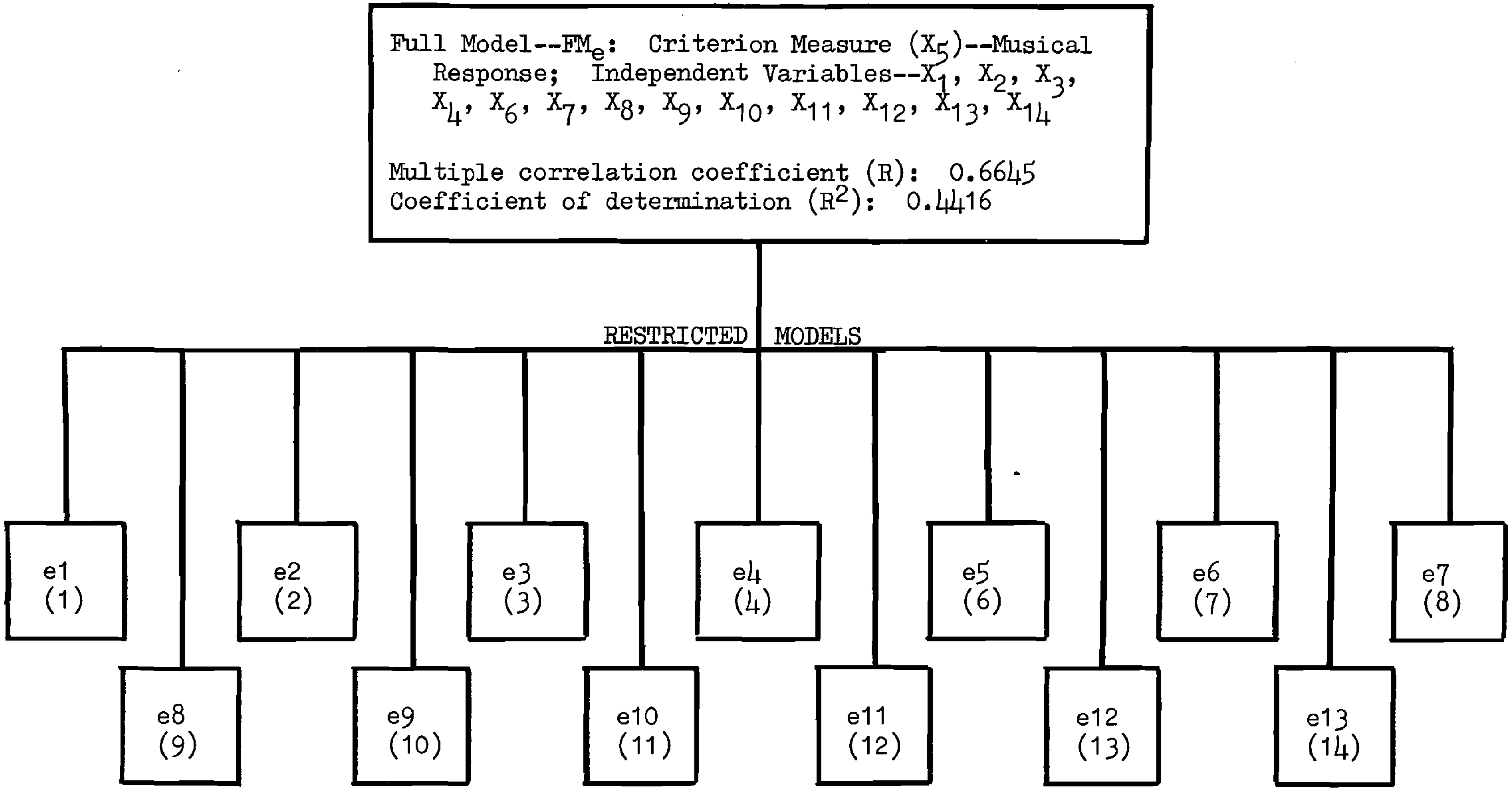

Chart 5. Multiple regression models with Musical Response as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

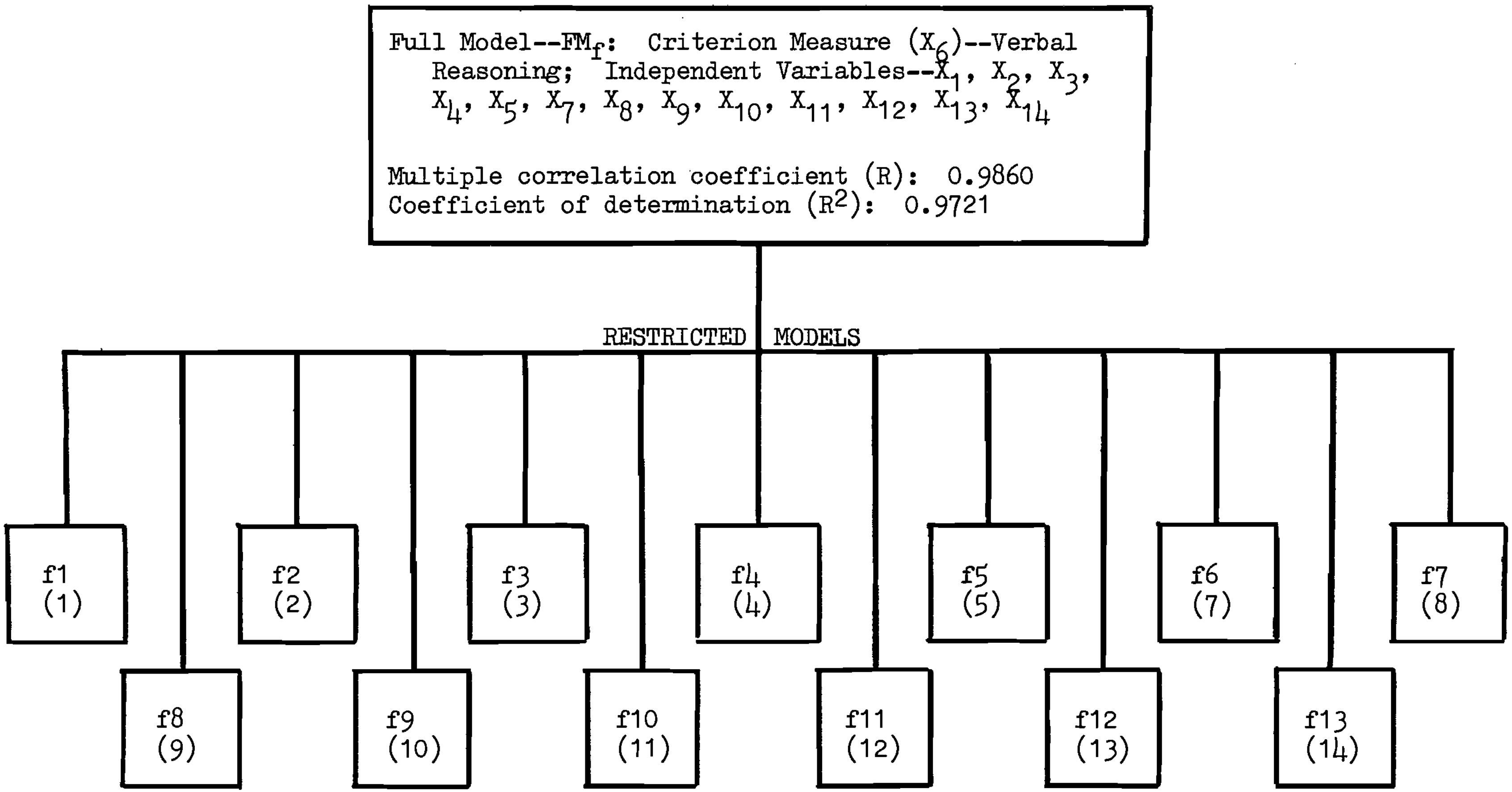

Chart 6. Multiple regression models with Verbal Reasoning as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

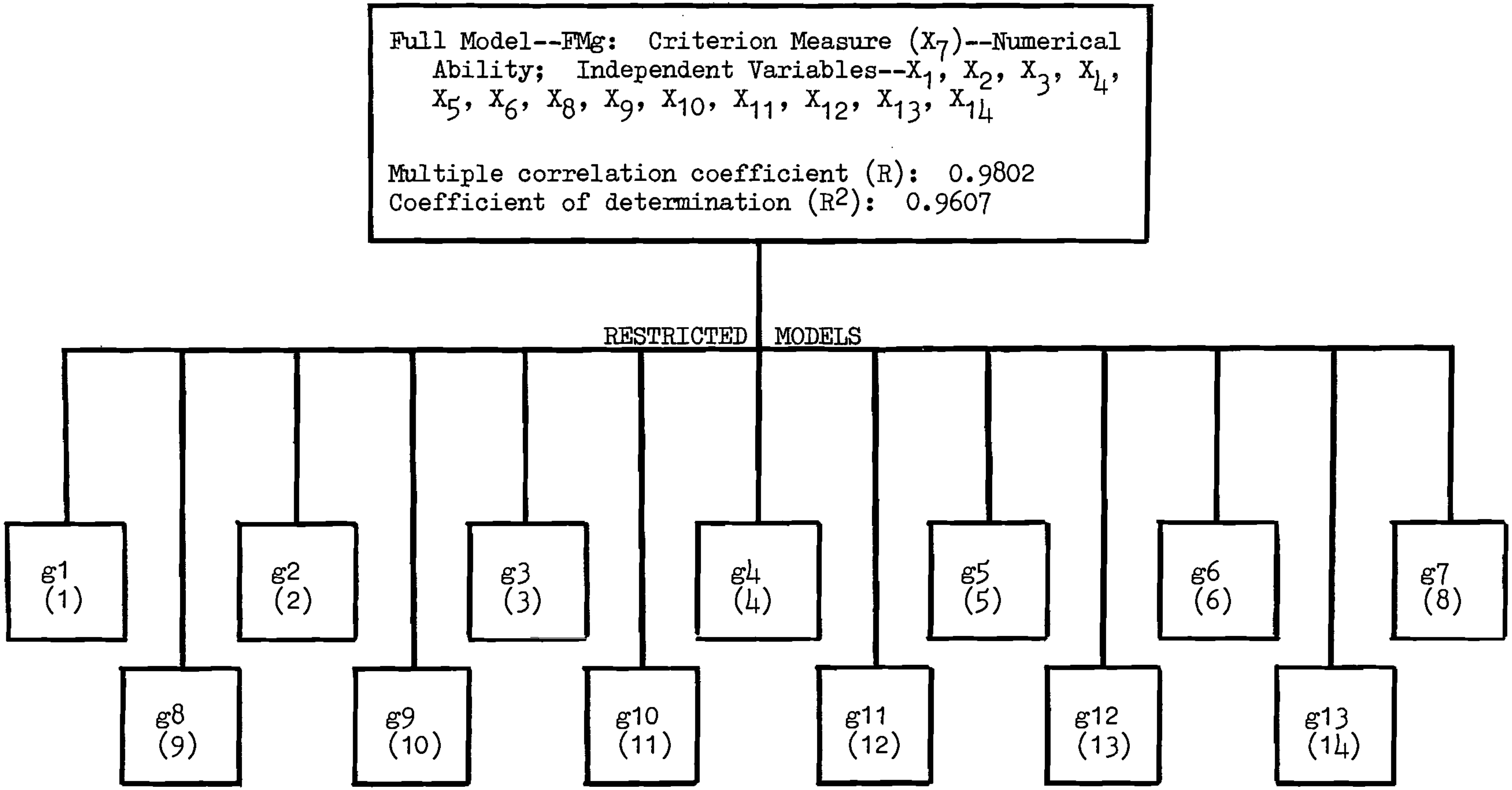

Chart 7. Multiple regression models with Numerical Ability as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

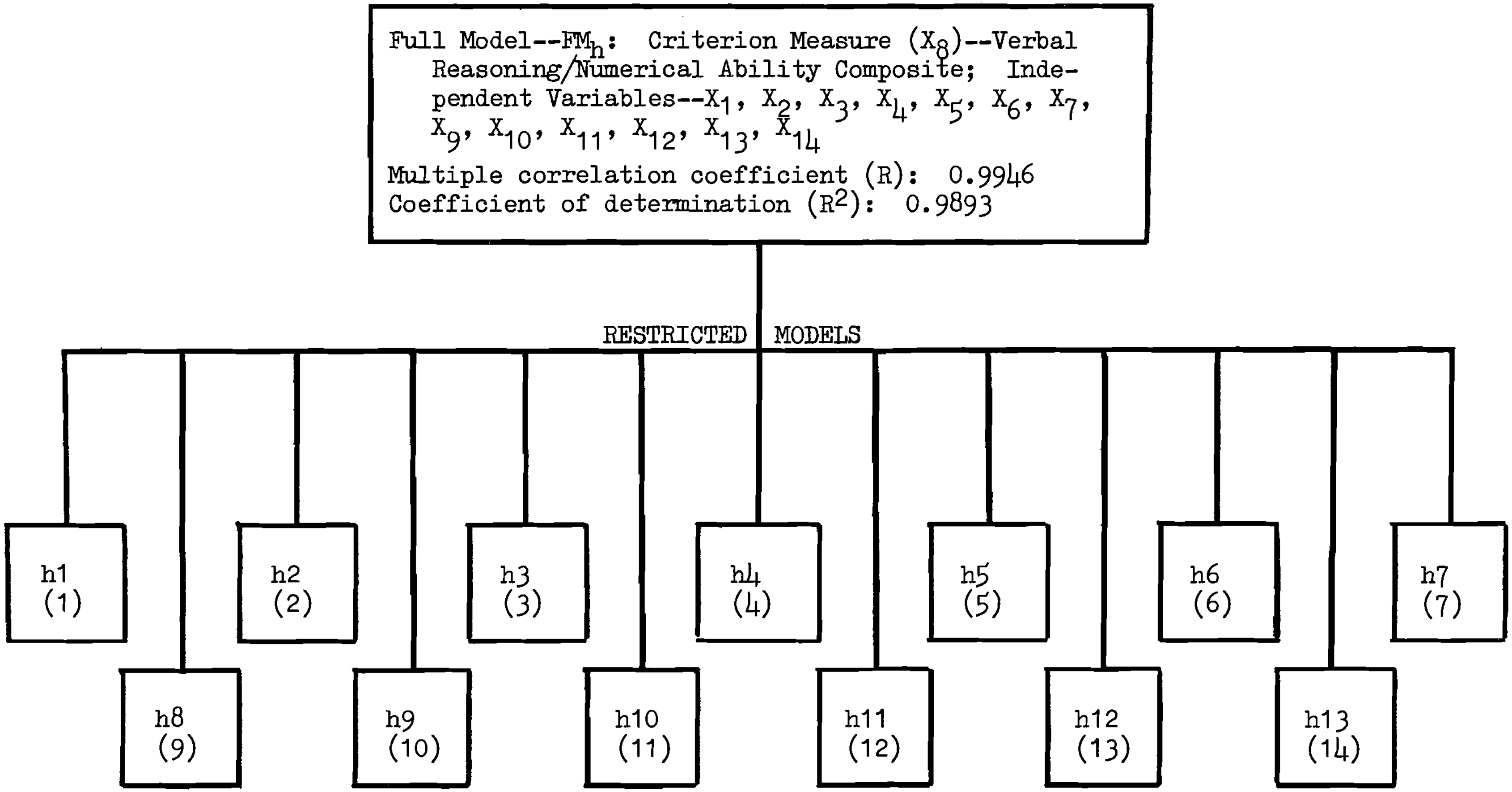

Chart 8. Multiple regression models with Verbal Reasoning/Numerical Ability Composite as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

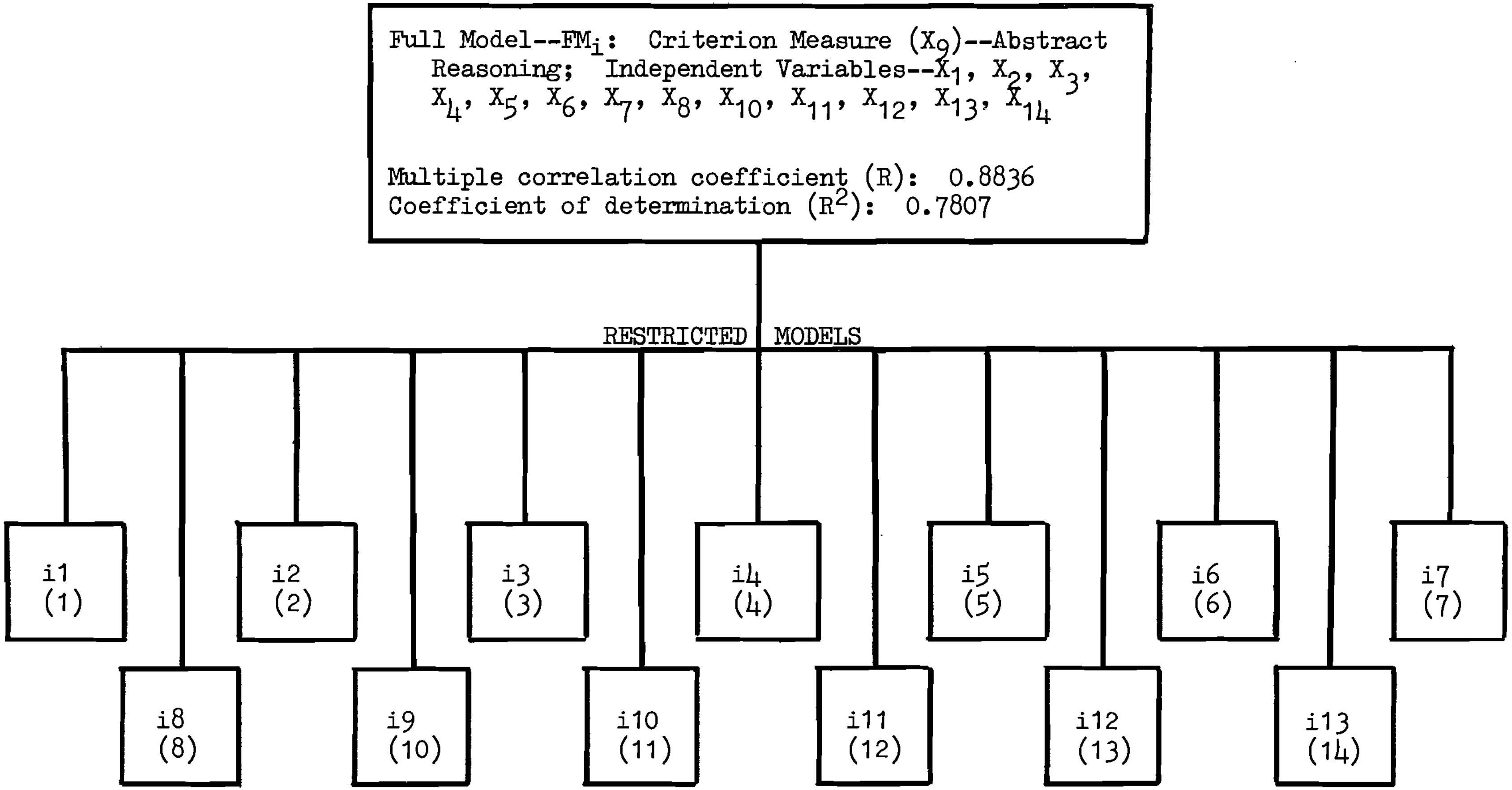

Chart 9. Multiple regression models with Abstract Reasoning as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

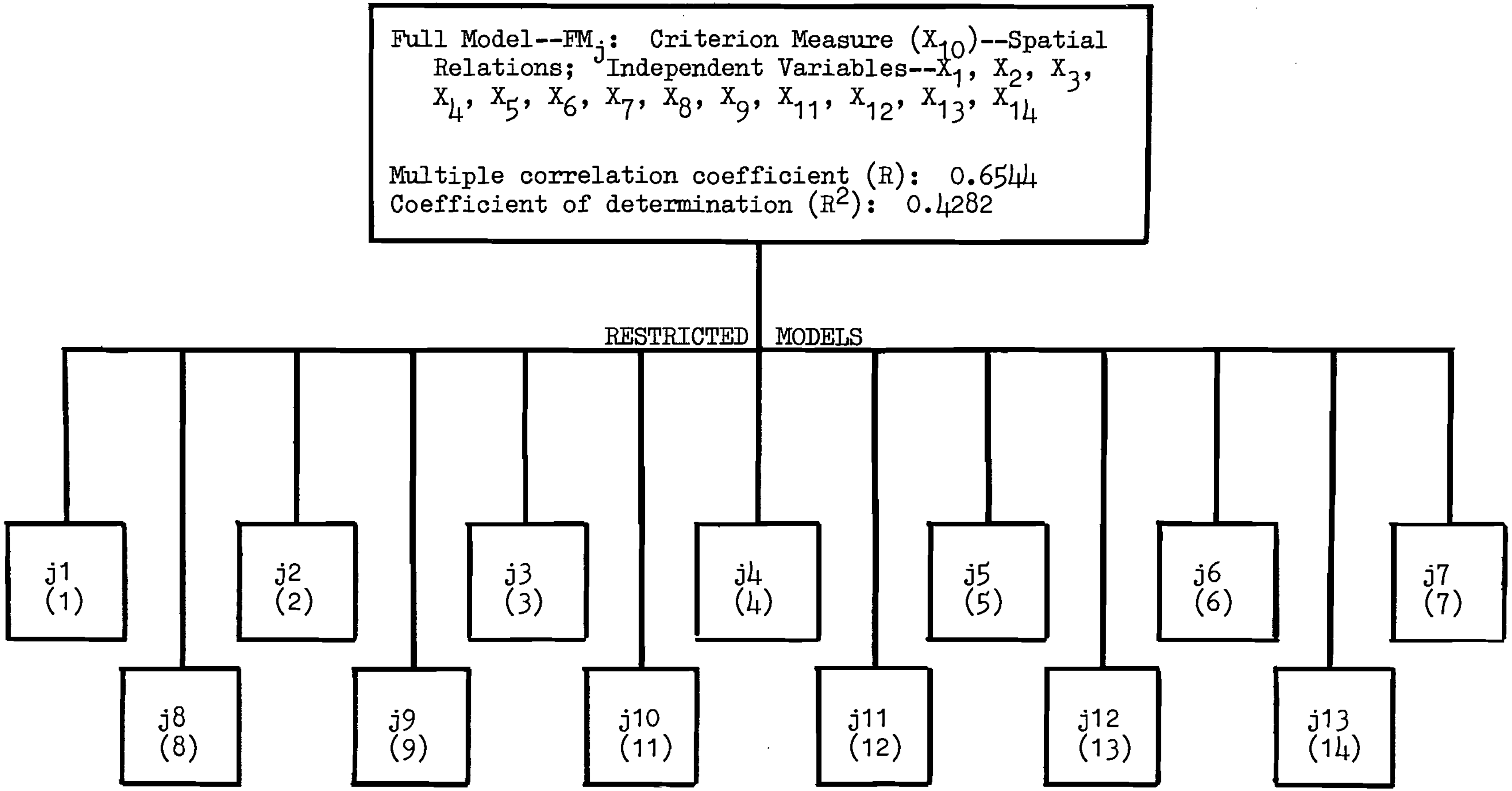

Chart 10. Multiple regression models with Spatial Relations as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

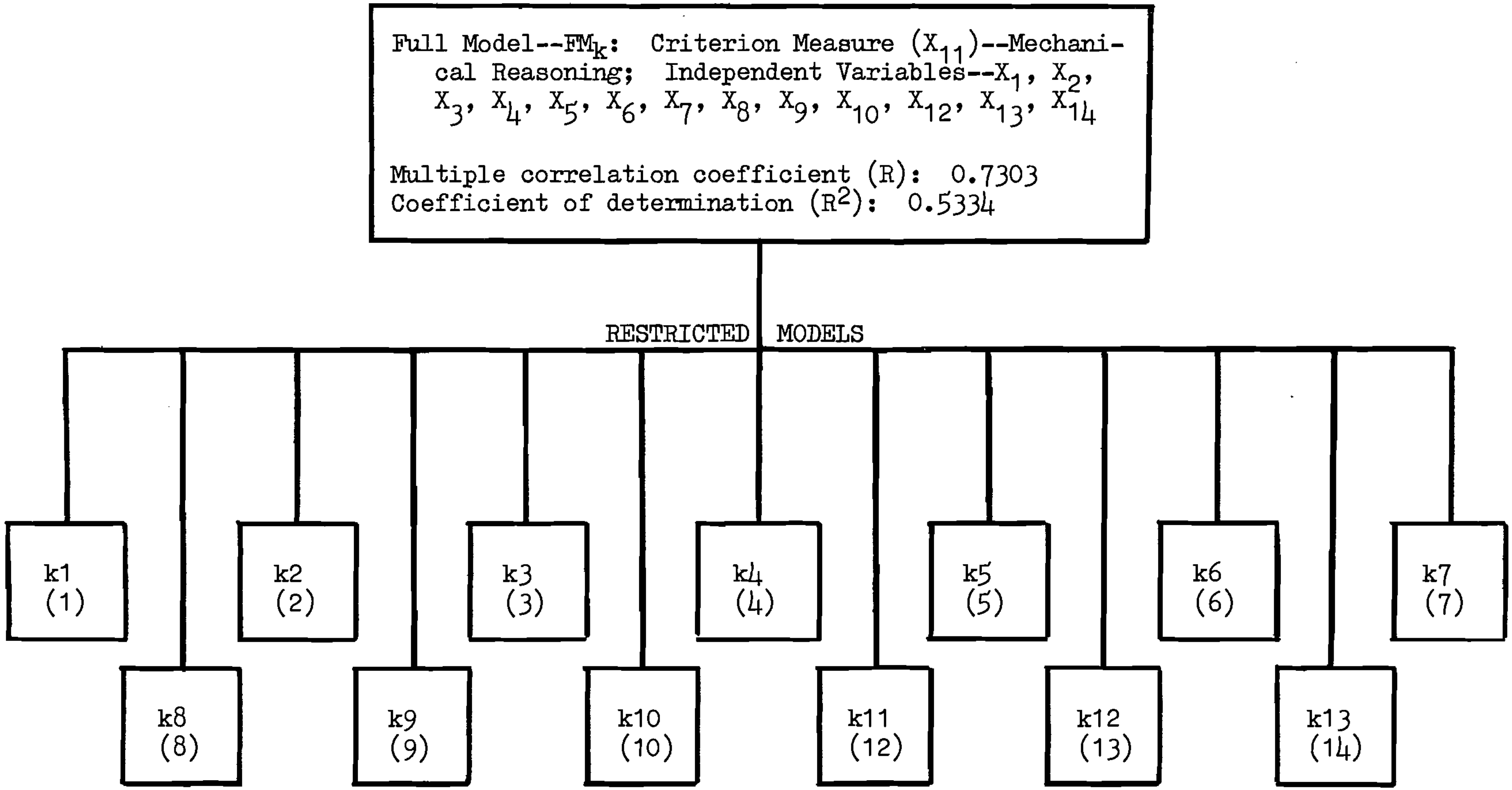

Chart 11. Multiple regression models with Mechanical Reasoning as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

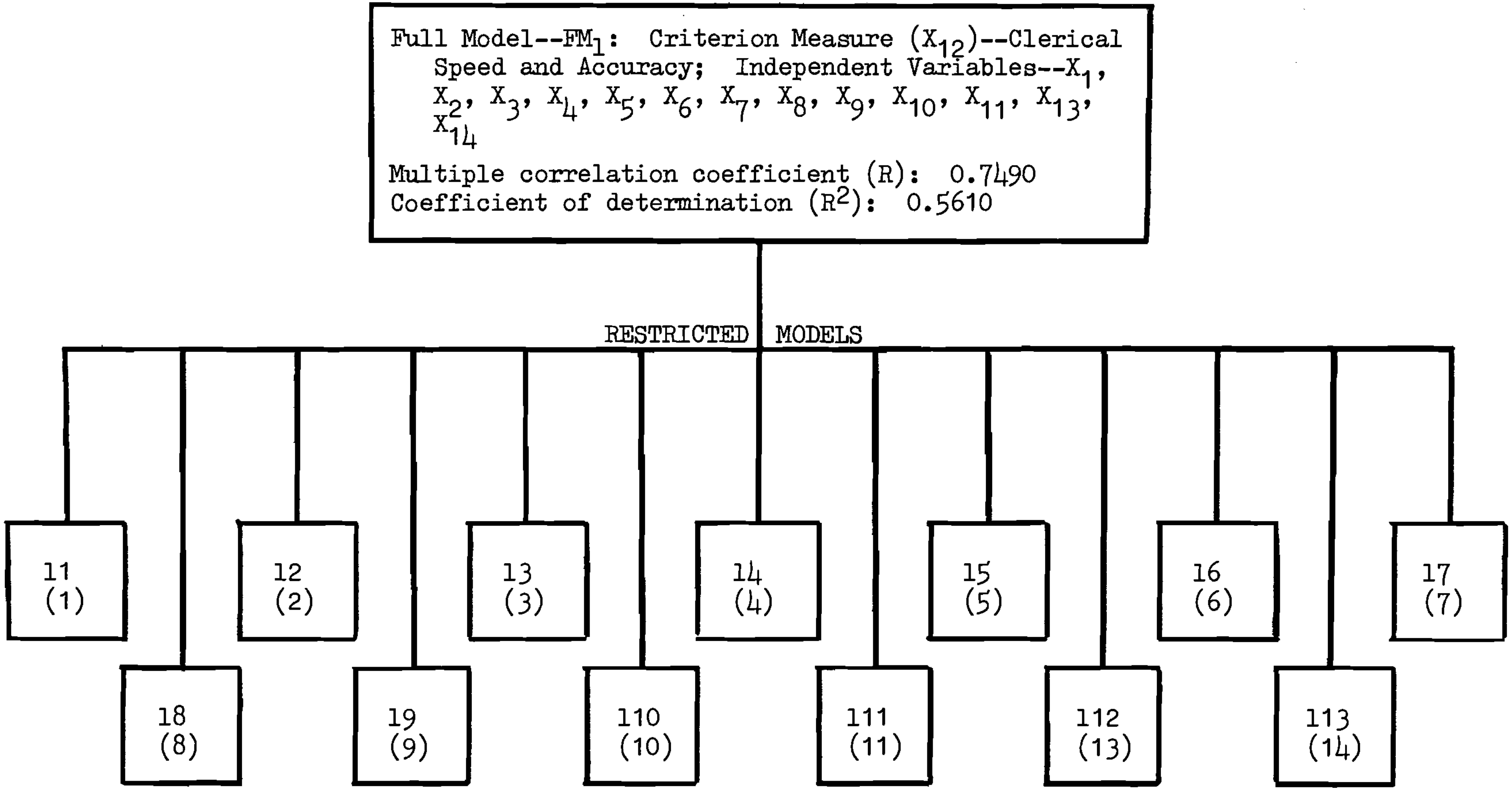

Chart 12. Multiple regression models with Clerical Speed and Accuracy as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

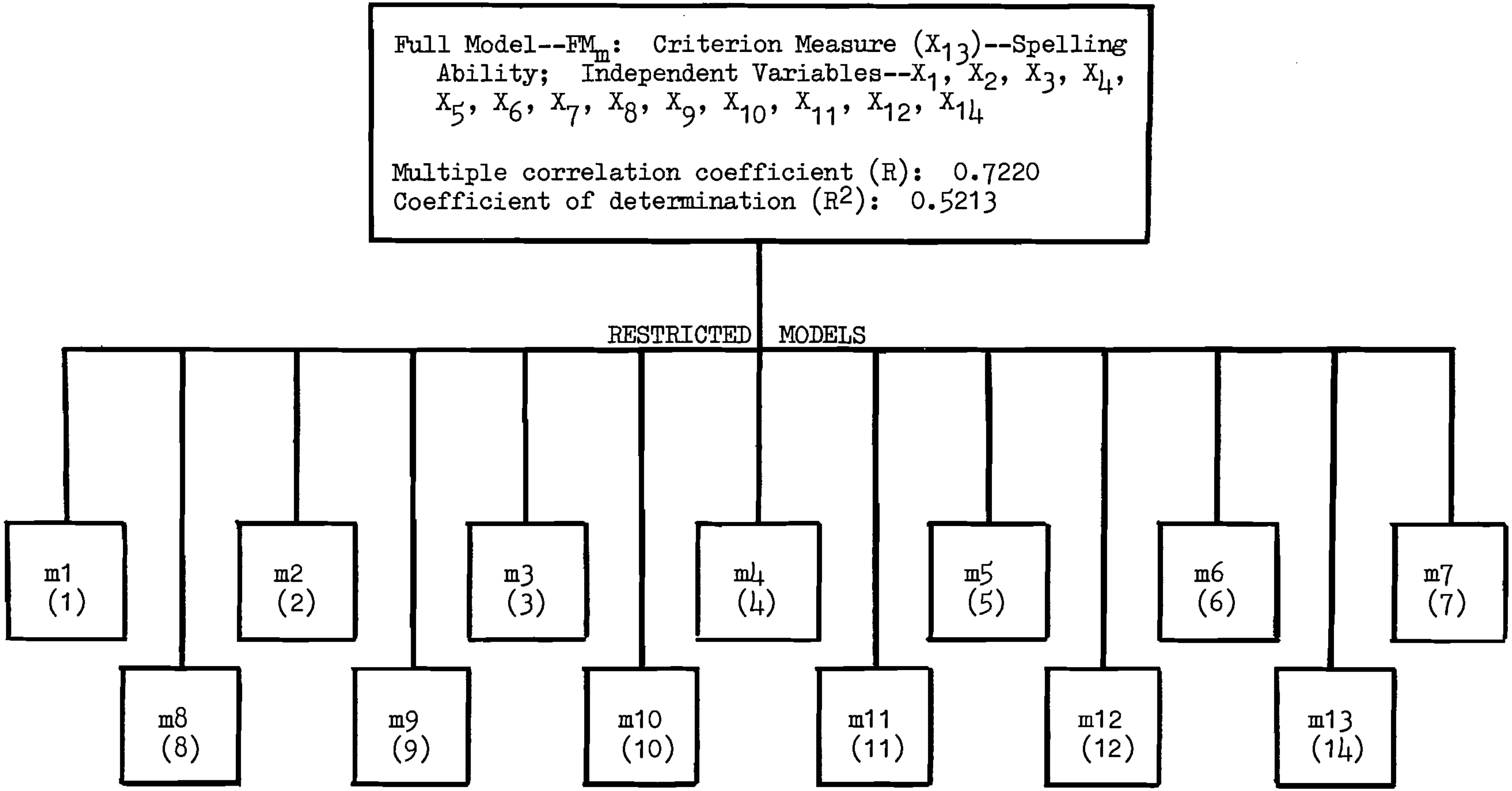

Chart 13. Multiple regression models with Spelling Ability as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

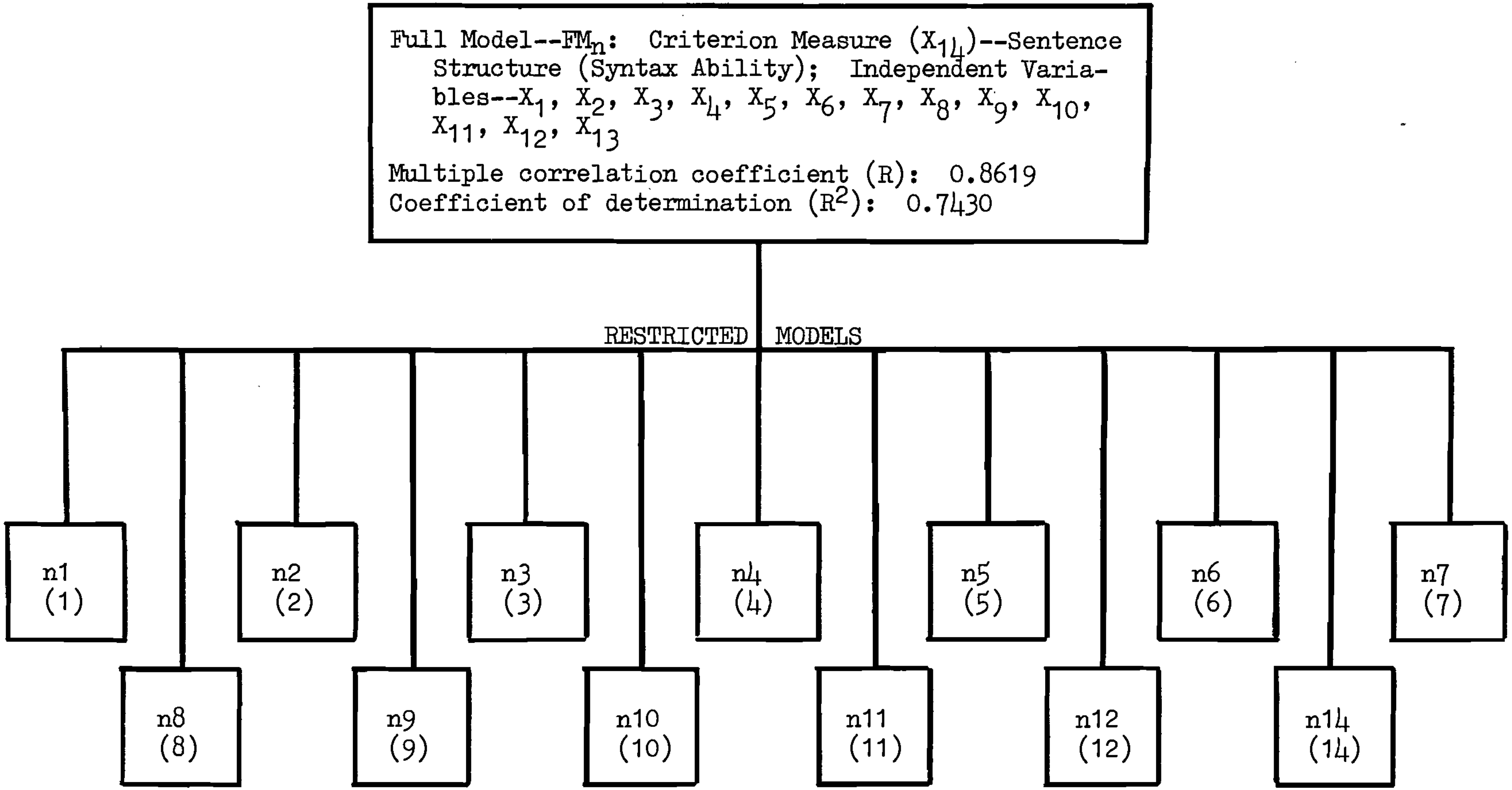

Chart 14. Multiple regression models with Syntax Ability as the criterion measure. Number shown in parenthesis indicates variable deleted from the full model.

With Chord-Tone Perception based on frequency of correct response as the criterion measure, the full model (FM_a) correlates significantly with a multiple correlation coefficient (R) of 0.9239. This shows a significant relationship between Chord-Tone Perception and FM_a beyond that of chance. A similar relationship exists between Chord-Tone Perception based on the sum of chord difficulty ratings and the full model FM_b with an R of 0.9223.

Table 2 lists the F-values computed for relationships between each variable in the full model (FM_a) and Chord-Tone Perception. An analysis of the data indicates that Tonal-Rhythmic Memory with an F of 20.320, Tonal-Rhythmic Contour Perception with an F of 17.720, Musical Response with an F of 21.421, Spatial Relations with an F of 22.118, Mechanical Reasoning with an F of 16.647, Clerical Speed and Accuracy with an F of 15.211, and Spelling Ability with an F of 17.278 all correlate significantly with Chord-Tone Perception with degrees of freedom equal to 1 and 52 at the .01 level of significance.

Table 3 lists the F-values computed for relationships between each variable in the full model (FM_b) and the criterion measure of Chord-Tone Perception based on chord difficulty ratings. All F-values computed in Tables 2 and 3 are nearly identical with the addition of one significant F in Table 3. Verbal Reasoning/Numerical Ability Composite relates significantly with an F of -7.213. Other significant F-values in Table 3 include Tonal-Rhythmic Memory at 20.167, Tonal-Rhythmic Contour Perception at 17.566, Musical Response at 21.268, Spatial Relations at 21.964, Mechanical Reasoning at 16.494, Clerical Speed and Accuracy at 15.057, and Spelling Ability at 17.124, all significant at the .01 level of significance.

Table 2

F-Values For Restricted Models Of FM_a With Criterion Measure: X_1= Chord-Tone Perception (Correct Response f)

Model	Omitted Variable	F-Value
RM_{a1}	X_2 Chord-Tone Perception (Difficulty Rating)	0.154
RM_{a2}	X_3 Tonal-Rhythmic Memory	20.320*
RM_{a3}	X_4 Tonal-Rhythmic Contour Perception	17.720*
RM_{a4}	X_5 Musical Response	21.421*
RM_{a5}	X_6 Verbal Reasoning	-6.165
RM_{a6}	X_7 Numerical Ability	-5.574
RM_{a7}	X_8 Verbal Reasoning/Numerical Ability Composite	-7.060
RM_{a8}	X_9 Abstract Reasoning	3.786
RM_{a9}	X_{10} Spatial Relations	22.118*
RM_{a10}	X_{11} Mechanical Reasoning	16.647*
RM_{a11}	X_{12} Clerical Speed and Accuracy	15.211*
RM_{a12}	X_{13} Spelling Ability	17.278*
RM_{a13}	X_{14} Sentence Structure (Syntax Ability)	5.751

For df = 1, 52 the F $\geq$ 7.17 at .01 level of significance (*)
For df = 1, 52 the F $\geq$ 4.03 at .05 level of significance

Table 3

F-Values For Restricted Models Of FM_b With Criterion Measure: X_2= Chord-Tone Perception (Difficulty Rating)

Model	Omitted Variable	F-Value
RM_{b1}	X_1 Chord-Tone Perception (Correct Response f)	-0.154
RM_{b2}	X_3 Tonal-Rhythmic Memory	20.167*
RM_{b3}	X_4 Tonal-Rhythmic Contour Perception	17.566*
RM_{b4}	X_5 Musical Response	21.268*
RM_{b5}	X_6 Verbal Reasoning	-6.319
RM_{b6}	X_7 Numerical Ability	-5.727
RM_{b7}	X_8 Verbal Reasoning/Numerical Ability Composite	-7.213*
RM_{b8}	X_9 Abstract Reasoning	3.632
RM_{b9}	X_{10} Spatial Relations	21.964*
RM_{b10}	X_{11} Mechanical Reasoning	16.494*
RM_{b11}	X_{12} Clerical Speed and Accuracy	15.057*
RM_{b12}	X_{13} Spelling Ability	17.124*
RM_{b13}	X_{14} Sentence Structure (Syntax Ability)	5.597

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

The R of 0.6803 between Tonal-Rhythmic Memory and the full model (FM_c) shows a relationship significantly better than chance. Table 4 contains the values of F computed for relationships between Tonal-Rhythmic Memory and each independent variable. Chord-Tone Perception with F-values of -20.320 and -20.167, Verbal Reasoning with an F of -26.485, Numerical Ability with an F of -25.894, Verbal Reasoning/Numerical Ability Composite with an F of -27.370, Abstract Reasoning with an F of -16.354, and Syntax Ability with an F of -14.569 correlate significantly with Tonal-Rhythmic Memory at the .01 level of significance.

The R of 0.7161 between Tonal-Rhythmic Contour Perception and the full model (FM_d) shows a relationship significantly better than chance. Table 5 lists the values of F computed for relationships between Tonal-Rhythmic Contour Perception and each independent variable. The variables which correlate significantly at the .01 level include Chord-Tone Perception with F-values of -17.720 and -17.566, Verbal Reasoning with an F of -23.885, Numerical Ability with an F of -23.294, Verbal Reasoning/Numerical Ability Composite with an F of -24.780, Abstract Reasoning with an F of -13.394, and Syntax Ability with an F of -11.969.

Musical Response and the full model (FM_e) correlate significantly at the .01 level with an R of 0.6645. Table 6 lists F-values computed by correlating the independent variables with Musical Response. Chord-Tone Perception with F-values of -21.421 and -21.268, Verbal Reasoning with an F of -27.586, Numerical Ability with an F of -26.995, Verbal Reasoning/Numerical Ability Composite with an F of -28.481, Abstract Reasoning with an F of -17.635, and Syntax Ability with an F of -15.670 all correlate significantly at the .01 level.

Table 4

F-Values For Restricted Models of FM_c With Criterion Measure: X_3= Tonal-Rhythmic Memory

Model	Omitted Variable	F-Value
RM_{c1}	X_1 Chord-Tone Perception (Correct Response f)	-20.320*
RM_{c2}	X_2 Chord-Tone Perception (Difficulty Rating)	-20.167*
RM_{c3}	X_4 Tonal-Rhythmic Contour Perception	-2.601
RM_{c4}	X_5 Musical Response	1.101
RM_{c5}	X_6 Verbal Reasoning	-26.485*
RM_{c6}	X_7 Numerical Ability	-25.894*
RM_{c7}	X_8 Verbal Reasoning/Numerical Ability Composite	-27.380*
RM_{c8}	X_9 Abstract Reasoning	-16.354*
RM_{c9}	X_{10} Spatial Relations	1.797
RM_{c10}	X_{11} Mechanical Reasoning	-3.673
RM_{c11}	X_{12} Clerical Speed and Accuracy	-5.109
RM_{c12}	X_{13} Spelling Ability	-3.042
RM_{c13}	X_{14} Sentence Structure (Syntax Ability)	-14.569*

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

Table 5

F-Values For Restricted Models of FM_d With Criterion Measure: X_4= Tonal-Rhythmic Contour Perception

Model	Omitted Variable	F-Value
RM_{d1}	X_1 Chord-Tone Perception (Correct Response f)	-17.720*
RM_{d2}	X_2 Chord-Tone Perception (Difficulty Rating)	-17.566*
RM_{d3}	X_3 Tonal-Rhythmic Memory	2.601
RM_{d4}	X_5 Musical Response	3.702
RM_{d5}	X_6 Verbal Reasoning	-23.885*
RM_{d6}	X_7 Numerical Ability	-23.294*
RM_{d7}	X_8 Verbal Reasoning/Numerical Ability Composite	-24.780*
RM_{d8}	X_9 Abstract Reasoning	-13.934*
RM_{d9}	X_{10} Spatial Relations	4.398
RM_{d10}	X_{11} Mechanical Reasoning	-1.072
RM_{d11}	X_{12} Clerical Speed and Accuracy	-2.509
RM_{d12}	X_{13} Spelling Ability	-0.442
RM_{d13}	X_{14} Sentence Structure (Syntax Ability)	-11.969*

For df = 1, 52 the F $\geq$ 7.17 at .01 level of significance (*)
For df = 1, 52 the F $\geq$ 4.03 at .05 level of significance

Table 6

F-Values For Restricted Models of FM_e With Criterion Measure: X_5= Musical Response

Model	Omitted Variable	F-Value
RM_{e1}	X_1 Chord-Tone Perception (Correct Response f)	-21.421*
RM_{e2}	X_2 Chord-Tone Perception (Difficulty Rating)	-21.268*
RM_{e3}	X_3 Tonal-Rhythmic Memory	-1.101
RM_{e4}	X_4 Tonal-Rhythmic Contour Perception	-3.702
RM_{e5}	X_6 Verbal Reasoning	-27.586*
RM_{e6}	X_7 Numerical Ability	-26.995*
RM_{e7}	X_8 Verbal Reasoning/Numerical Ability Composite	-28.481*
RM_{e8}	X_9 Abstract Reasoning	-17.635*
RM_{e9}	X_{10} Spatial Relations	0.696
RM_{e10}	X_{11} Mechanical Reasoning	-4.774
RM_{e11}	X_{12} Clerical Speed and Accuracy	-6.210
RM_{e12}	X_{13} Spelling Ability	-4.143
RM_{e13}	X_{14} Sentence Structure (Syntax Ability)	-15.670*

For df = 1, 52 the $F \geqslant 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \gtrsim 4.03$ at .05 level of significance

The R of 0.9860 between Verbal Reasoning and the full model (FM_f) shows a relationship significantly better than chance. Table 7 contains the values of F computed for relationships between Verbal Reasoning and each independent variable. Tonal-Rhythmic Memory with an F of 26.485, Tonal-Rhythmic Contour Perception with an F of 23.885, Musical Response with an F of 27.586, Abstract Reasoning with an F of 9.951, Spatial Relations with an F of 28.283, Mechanical Reasoning with an F of 22.812, Clerical Speed and Accuracy with an F of 21.376, Spelling Ability with an F of 23.443, and Syntax Ability with an F of 11.916 correlate significantly with Verbal Reasoning at the .01 level of significance.

Numerical Ability and the full model (FM_g) correlate significantly at the .01 level with an R of 0.9802. Table 8 lists F-values computed by correlating the independent variables with Numerical Ability. The variables which correlate significantly at the .01 level of significance include Tonal-Rhythmic Memory with an F of 25.894, Tonal-Rhythmic Contour Perception with an F of 23.294, Musical Response with an F of 26.995, Abstract Reasoning with an F of 9.360, Spatial Relations with an F of 27.691, Mechanical Reasoning with an F of 22.221, Clerical Speed and Accuracy with an F of 20.785, Spelling Ability with an F of 22.852, and Syntax Ability with an F of 11.325.

The R of 0.9946 between Verbal Reasoning/Numerical Ability Composite and the full model (FM_h) shows a relationship significantly better than chance. Table 9 lists F-values computed by correlating the independent variables with the Verbal Reasoning/Numerical Ability Composite. The F-values in Tables 7, 8, and 9 compare closely. Table 9, however, contains one additional F significant at the .01 level.

Table 7

F-Values For Restricted Models of FM_f With Criterion Measure: X_6= Verbal Reasoning

Model	Omitted Variable	F-Value
RM_{f1}	X_1 Chord-Tone Perception (Correct Response f)	6.165
RM_{f2}	X_2 Chord-Tone Perception (Difficulty Rating)	6.319
RM_{f3}	X_3 Tonal-Rhythmic Memory	26.485*
RM_{f4}	X_4 Tonal-Rhythmic Contour Perception	23.885*
RM_{f5}	X_5 Musical Response	27.586*
RM_{f6}	X_7 Numerical Ability	0.591
RM_{f7}	X_8 Verbal Reasoning/Numerical Ability Composite	-0.895
RM_{f8}	X_9 Abstract Reasoning	9.951*
RM_{f9}	X_{10} Spatial Relations	28.283*
RM_{f10}	X_{11} Mechanical Reasoning	22.812*
RM_{f11}	X_{12} Clerical Speed and Accuracy	21.376*
RM_{f12}	X_{13} Spelling Ability	23.443*
RM_{f13}	X_{14} Sentence Structure (Syntax Ability)	11.916*

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

Table 8

F-Values For Restricted Models of FM_g With Criterion Measure: X_7= Numerical Ability

Model	Omitted Variable	F-Value
RM_{g1}	X_1 Chord-Tone Perception (Correct Response ƒ)	5.574
RM_{g2}	X_2 Chord-Tone Perception (Difficulty Rating)	5.727
RM_{g3}	X_3 Tonal-Rhythmic Memory	25.894*
RM_{g4}	X_4 Tonal-Rhythmic Contour Perception	23.294*
RM_{g5}	X_5 Musical Response	26.995*
RM_{g6}	X_6 Verbal Reasoning	-0.591
RM_{g7}	X_8 Verbal Reasoning/Numerical Ability Composite	-1.486
RM_{g8}	X_9 Abstract Reasoning	9.360*
RM_{g9}	X_{10} Spatial Relations	27.691*
RM_{g10}	X_{11} Mechanical Reasoning	22.221*
RM_{g11}	X_{12} Clerical Speed and Accuracy	20.785*
RM_{g12}	X_{13} Spelling Ability	22.852*
RM_{g13}	X_{14} Sentence Structure (Syntax Ability)	11.325*

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

Table 9

F-Values For Restricted Models of FM_h With Criterion Measure:
X_8= Verbal Reasoning/Numerical Ability Composite

Model	Omitted Variable	F-Value
RM_{h1}	X_1 Chord-Tone Perception (Correct Response f)	7.060
RM_{h2}	X_2 Chord-Tone Perception (Difficulty Rating)	7.213*
RM_{h3}	X_3 Tonal-Rhythmic Memory	27.380*
RM_{h4}	X_4 Tonal-Rhythmic Contour Perception	24.780*
RM_{h5}	X_5 Musical Response	28.481*
RM_{h6}	X_6 Verbal Reasoning	0.895
RM_{h7}	X_7 Numerical Ability	1.486
RM_{h8}	X_9 Abstract Reasoning	10.846*
RM_{h9}	X_{10} Spatial Relations	29.178*
RM_{h10}	X_{11} Mechanical Reasoning	23.707*
RM_{h11}	X_{12} Clerical Speed and Accuracy	22.271*
RM_{h12}	X_{13} Spelling Ability	24.338*
RM_{h13}	X_{14} Sentence Structure (Syntax Ability)	12.811*

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

Chord-Tone Perception correlates significantly with an F of 7.213. Other significant F-values include Tonal-Rhythmic Memory at 27.380, Tonal-Rhythmic Contour Perception at 24.780, Musical Response at 28.481, Abstract Reasoning at 10.846, Spatial Relations at 29.178, Mechanical Reasoning at 23.707, Clerical Speed and Accuracy at 22.271, Spelling Ability at 24.338, and Syntax Ability at 12.811.

Abstract Reasoning and the full model (FM_i) correlate significantly at the .01 level with an R of 0.8836. Table 10 lists F-values computed by correlating the independent variables with Abstract Reasoning. The variables which relate significantly at the .01 level include Tonal-Rhythmic Memory with an F of 16.354, Tonal-Rhythmic Contour Perception with an F of 13.934, Musical Response with an F of 17.635, Verbal Reasoning with an F of -9.951, Numerical Ability with an F of -9.360, Verbal Reasoning/Numerical Ability Composite with an F of -10.846, Spatial Relations with an F of 18.332, Mechanical Reasoning with an F of 12.861, Clerical Speed and Accuracy with an F of 11.425, and Spelling Ability with an F of 13.492.

The R of 0.6544 between Spatial Relations and the full model (FM_j) shows a relationship significantly better than chance at the .01 level. Table 11 lists the values of F computed for relationships between Spatial Relations and each independent variable. Chord-Tone Perception with F-values of -22.118 and -21.964, Verbal Reasoning with an F of -28.283, Numerical Ability with an F of -27.691, Verbal Reasoning/Numerical Ability Composite with an F of -29.178, Abstract Reasoning with an F of -18.332, and Syntax Ability with an F of -16.367 all correlate significantly with Spatial Relations at the .01 level of significance.

Table 10

F-Values For Restricted Models of FM_i With Criterion Measure: X_9= Abstract Reasoning

Model	Omitted Variable	F-Value
RM_{i1}	X_1 Chord-Tone Perception (Correct Response f)	-3.786
RM_{i2}	X_2 Chord-Tone Perception (Difficulty Rating)	-3.632
RM_{i3}	X_3 Tonal-Rhythmic Memory	16.354*
RM_{i4}	X_4 Tonal-Rhythmic Contour Perception	13.934*
RM_{i5}	X_5 Musical Response	17.635*
RM_{i6}	X_6 Verbal Reasoning	-9.951*
RM_{i7}	X_7 Numerical Ability	-9.360*
RM_{i8}	X_8 Verbal Reasoning/Numerical Ability Composite	-10.846*
RM_{i9}	X_{10} Spatial Relations	18.332*
RM_{i10}	X_{11} Mechanical Reasoning	12.861*
RM_{i11}	X_{12} Clerical Speed and Accuracy	11.425*
RM_{i12}	X_{13} Spelling Ability	13.492*
RM_{i13}	X_{14} Sentence Structure (Syntax Ability)	1.965

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

Table 11

F-Values For Restricted Models of FM_j With Criterion Measure: X_{10}= Spatial Relations

Model	Omitted Variable	F-Value
RM_{j1}	X_1 Chord-Tone Perception (Correct Response ƒ)	-22.118*
RM_{j2}	X_2 Chord-Tone Perception (Difficulty Rating)	-21.964*
RM_{j3}	X_3 Tonal-Rhythmic Memory	-1.797
RM_{j4}	X_4 Tonal-Rhythmic Contour Perception	-4.398
RM_{j5}	X_5 Musical Response	-0.696
RM_{j6}	X_6 Verbal Reasoning	-28.283*
RM_{j7}	X_7 Numerical Ability	-27.691*
RM_{j8}	X_8 Verbal Reasoning/Numerical Ability Composite	-29.178*
RM_{j9}	X_9 Abstract Reasoning	-18.332*
RM_{j10}	X_{11} Mechanical Reasoning	-5.470
RM_{j11}	X_{12} Clerical Speed and Accuracy	-6.907
RM_{j12}	X_{13} Spelling Ability	-4.840
RM_{j13}	X_{14} Sentence Structure (Syntax Ability)	-16.367*

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

Mechanical Reasoning and the full model (FM_k) correlate significantly at the .01 level with an R of 0.7303. Table 12 lists F-values that were computed by correlating the independent variables with Abstract Reasoning. The variables which relate significantly at the .01 level include Chord-Tone Perception with an F of -16.647 and an F of -16.494, Verbal Reasoning with an F of -22.812, Numerical Ability with an F of -22.221, Verbal Reasoning/Numerical Ability Composite with an F of -23.707, Abstract Reasoning with an F of -12.861, and Syntax Ability with an F of -10.896.

The R of 0.7490 between Clerical Speed and Accuracy and the full model FM_l shows a relationship significantly better than chance at the .01 level. Table 13 contains the values of F computed for relationships between Clerical Speed and Accuracy and each independent variable. Chord-Tone Perception with F-values of -15.211 and -15.057, Verbal Reasoning with an F of -21.376, Numerical Ability with an F of -20.785, Verbal Reasoning/Numerical Ability Composite with an F of -22.271, Abstract Reasoning with an F of -11.425, and Syntax Ability with an F of -9.460 all correlate significantly with Clerical Speed and Accuracy at the .01 level.

Spelling Ability and the full model (FM_m) correlate significantly at the .01 level with an R of 0.7220. The F-values listed in Table 14 were computed by correlating Spelling Ability with each of the independent variables. The variables which relate significantly at the .01 level include Chord-Tone Perception with F-values of -17.278 and -17.124, Verbal Reasoning with an F of -23.443, Numerical Ability with an F of -22.852, Verbal Reasoning/Numerical Ability Composite with an F of -24.338, Abstract Reasoning with an F of -13.492,

Table 12

F-Values For Restricted Models of FM_k With Criterion Measure: X_{11}= Mechanical Reasoning

Model	Omitted Variable	F-Value
RM_{k1}	X_1 Chord-Tone Perception (Correct Response f)	-16.647*
RM_{k2}	X_2 Chord-Tone Perception (Difficulty Rating)	-16.494*
RM_{k3}	X_3 Tonal-Rhythmic Memory	3.673
RM_{k4}	X_4 Tonal-Rhythmic Contour Perception	1.072
RM_{k5}	X_5 Musical Response	4.774
RM_{k6}	X_6 Verbal Reasoning	-22.812*
RM_{k7}	X_7 Numerical Ability	-22.221*
RM_{k8}	X_8 Verbal Reasoning/Numerical Ability Composite	-23.707*
RM_{k9}	X_9 Abstract Reasoning	-12.861*
RM_{k10}	X_{10} Spatial Relations	5.470
RM_{k11}	X_{12} Clerical Speed and Accuracy	-1.436
RM_{k12}	X_{13} Spelling Ability	0.631
RM_{k13}	X_{14} Sentence Structure (Syntax Ability)	-10.896*

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

Table 13

F-Values For Restricted Models Of FM_1 With Criterion Measure: X_{12}= Clerical Speed and Accuracy

Model	Omitted Variable	F-Value
RM_{11}	X_1 Chord-Tone Perception (Correct Response ƒ)	-15.211*
RM_{12}	X_2 Chord-Tone Perception (Difficulty Rating)	-15.057*
RM_{13}	X_3 Tonal-Rhythmic Memory	5.109
RM_{14}	X_4 Tonal-Rhythmic Contour Perception	2.509
RM_{15}	X_5 Musical Response	6.210
RM_{16}	X_6 Verbal Reasoning	-21.376*
RM_{17}	X_7 Numerical Ability	-20.785*
RM_{18}	X_8 Verbal Reasoning/Numerical Ability Composite	-22.271*
RM_{19}	X_9 Abstract Reasoning	-11.425*
RM_{110}	X_{10} Spatial Relations	6.907
RM_{111}	X_{11} Mechanical Reasoning	1.436
RM_{112}	X_{13} Spelling Ability	2.067
RM_{113}	X_{14} Sentence Structure (Syntax Ability)	-9.460*

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

Table 14

F-Values For Restricted Models Of FM_m With Criterion Measure: X_{13}= Spelling Ability

Model	Omitted Variable	F-Value
RM_{m1}	X_1 Chord-Tone Perception (Correct Response f)	-17.278*
RM_{m2}	X_2 Chord-Tone Perception (Difficulty Rating)	-17.124*
RM_{m3}	X_3 Tonal-Rhythmic Memory	3.042
RM_{m4}	X_4 Tonal-Rhythmic Contour Perception	0.442
RM_{m5}	X_5 Musical Response	4.143
RM_{m6}	X_6 Verbal Reasoning	-23.443*
RM_{m7}	X_7 Numerical Ability	-22.852*
RM_{m8}	X_8 Verbal Reasoning/Numerical Ability Composite	-24.338*
RM_{m9}	X_9 Abstract Reasoning	-13.492*
RM_{m10}	X_{10} Spatial Relations	4.840
RM_{m11}	X_{11} Mechanical Reasoning	-0.631
RM_{m12}	X_{12} Clerical Speed and Accuracy	-2.067
RM_{m13}	X_{14} Sentence Structure (Syntax Ability)	-11.527*

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

and Sentence Structure (Syntax Ability) with an F of -11.527.

The R of 0.8619 between Sentence Structure (Syntax Ability) and the full model (FM_n) is significant at the .01 level. Table 15 lists the F-values that were computed by correlating the independent variables with the criterion measure of Sentence Structure (Syntax Ability). Tonal-Rhythmic Memory with an F of 14.569, Tonal-Rhythmic Contour Perception with an F of 11.969, Musical Response with an F of 15.670, Verbal Reasoning with an F of -11.916, Numerical Ability with an F of -11.325, Verbal Reasoning/Numerical Ability Composite with an F of -12.811, Spatial Relations with an F of 16.367, Mechanical Reasoning with an F of 10.896, Clerical Speed and Accuracy with an F of 9.460, and Spelling Ability with an F of 11.527 all correlate significantly with Sentence Structure (Syntax Ability) at the .01 level.

Table 15

F-Values For Restricted Models Of FM_n With Criterion Measure: X_{14}= Sentence Structure (Syntax Ability)

Model	Omitted Variable	F-Value
RM_{n1}	X_1 Chord-Tone Perception (Correct Response f)	-5.751
RM_{n2}	X_2 Chord-Tone Perception (Difficulty Rating)	-5.597
RM_{n3}	X_3 Tonal-Rhythmic Memory	14.569*
RM_{n4}	X_4 Tonal-Rhythmic Contour Perception	11.969*
RM_{n5}	X_5 Musical Response	15.670*
RM_{n6}	X_6 Verbal Reasoning	-11.916*
RM_{n7}	X_7 Numerical Ability	-11.325*
RM_{n8}	X_8 Verbal Reasoning/Numerical Ability Composite	-12.811*
RM_{n9}	X_9 Abstract Reasoning	-1.965
RM_{n10}	X_{10} Spatial Relations	16.367*
RM_{n11}	X_{11} Mechanical Reasoning	10.896*
RM_{n12}	X_{12} Clerical Speed and Accuracy	9.460*
RM_{n13}	X_{13} Spelling Ability	11.527*

For df = 1, 52 the $F \geq 7.17$ at .01 level of significance (*)
For df = 1, 52 the $F \geq 4.03$ at .05 level of significance

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The focus, design and analysis of the data of this study are summarized in this chapter. Conclusions that were drawn on the basis of the results of the study are discussed. Recommendations for further study are also included herein.

SUMMARY

This study was concerned with musical learning theory. Specifically, it was designed to discover the presence of any interrelationships among musical perception, musical response, and differential aptitudes. Eighth-grade students were selected for this study for several reasons. The Differential Aptitude Tests had been taken only a few months before the music tests were given to the same students, thereby providing recently acquired data. In addition, the eighth-grade student has had generally fewer formal musical experiences than an older student. Moreover, the results from a study of eighth-grade students will provide implications to music educators of the elementary and secondary levels.

A total of fourteen measures were analyzed by the multiple regression method. Each factor was set as the criterion variable, and the influence of the other factors upon the criterion variable was measured. Through this analysis, certain interrelationships were found to exist.

The musical factors that were found to have a definite effect on Chord-Tone Perception were Tonal-Rhythmic Memory, Tonal-Rhythmic Contour Perception, and Musical Response. Differential aptitudes which played significant roles in determining Chord-Tone Perception were Verbal Reasoning/Numerical Ability Composite, Spatial Relations, Mechanical Reasoning, Clerical Speed and Accuracy, and Spelling Ability.

Tonal-Rhythmic Memory, Tonal-Rhythmic Contour Perception, and Musical Response were all effected significantly at the .01 level by variances in certain factors. These included Chord-Tone Perception, Verbal Reasoning, Numerical Ability, Verbal Reasoning/Numerical Ability Composite, Abstract Reasoning, and Sentence Structure (Syntax Ability).

Further analysis of the data shows that the aptitudes of Verbal Reasoning and Numerical Ability were both significantly effected by variance in Tonal-Rhythmic Memory, Tonal-Rhythmic Contour Perception, Musical Response, Abstract Reasoning, Spatial Relations, Mechanical Reasoning, Clerical Speed and Accuracy, Spelling Ability, and Syntax Ability. The Verbal Reasoning/Numerical Ability Composite was shown to be determined significantly by all musical perception, musical response, and differential aptitude factors.

Abstract Reasoning appeared to be determined significantly by the musical factors of Tonal-Rhythmic Memory, Tonal-Rhythmic Contour Perception, and Musical Response. In addition, it was also effected by variances in Verbal Reasoning, Numerical Ability, Verbal Reasoning/Numerical Ability Composite, Spatial Relations, Mechanical Reasoning, Clerical Speed and Accuracy, and Spelling Ability.

Spatial Relations, Mechanical Reasoning, Clerical Speed and Accuracy, and Spelling Ability were all found to be determined significantly by the same factors. These included only one musical factor, Chord-Tone Perception. They also included the differential aptitudes of Verbal Reasoning, Numerical Ability, Verbal Reasoning/Numerical Ability Composite, Abstract Reasoning, and Syntax Ability.

Further analysis of the data revealed Syntax Ability to be significantly determined by variation in Tonal-Rhythmic Memory, Tonal-Rhythmic Contour Perception, and Musical Response. Of the differential aptitudes, Verbal Reasoning, Numerical Ability, Verbal Reasoning/Numerical Ability Composite, Spatial Relations, Mechanical Reasoning, Clerical Speed and Accuracy, and Spelling Ability were shown to have a significant effect on Syntax Ability.

CONCLUSIONS

The hypothesis stated in Chapter 1 that there is no significant correlation between measures of musical perception, musical response, and differential aptitudes in the eighth-grade student was rejected. The results of this study show that as each factor of musical perception, musical response and differential aptitudes was set as the criterion measure, both musical and differential aptitude factors affected the criterion measure significantly at the .01 level. This indicates the existence of marked interrelationships.

The findings support the belief that certain cognitive aptitudes have a direct bearing upon musical learning. This conclusion validates the purpose behind studies done by Pflederer, Botvin, and Larsen, where Piagetian developmental theory was applied to musical learning. The only factor which seemed to have a significant effect on all of the aspects measured for musical perception and musical response was the Verbal Reasoning/Numerical Ability Composite. Since this score is a general scholastic aptitude measure similar in function to the I. Q., the results indicate that general aptitude or intelligence has a direct bearing upon musical perception.

It was found that there was a marked difference in the factors which related to Chord-Tone Perception and the factors which related to the other musical measurements. The existence of two apparently exclusive sets of factors related to musical learning supports the belief that at least two fundamental aptitudes are in operation in musical learning. The process of acquiring one type of musical perception (for example, Chord-Tone) may not be the same process one applies to the acquiring of another (for example, Tonal-Rhythmic Contour).

The results found in comparing the measures of Chord-Tone Perception based on frequency of correct response and based on the chord difficulty ratings revealed that the number of correct responses given by the students correlated with a very high r (0.9118) with the scores based on difficulty ratings. This relationship seems to indicate that simple structures are perceived and learned before much more complex structures of the same phenomenon can be perceived and learned.

The relationships existing between Chord-Tone Perception and the set of differential aptitudes composed of Spatial Relations, Mechanical Reasoning, Clerical Speed and Accuracy, and Spelling Ability, spawn interesting theories. The Spatial Relations measure is concerned partly with the composition of the whole from its parts. Spelling Ability also deals with parts (letters or phonemes) forming a whole and the perception of the proper parts needed to construct the whole. These concepts may have strong implications for the acquisition of Chord-

Tone Perception.

The correlations of Tonal-Rhythmic Memory and Tonal-Rhythmic Contour Perception with the set of differential aptitudes composed of Verbal Reasoning, Numerical Ability, Abstract Reasoning, and Syntax Ability pose interesting possibilities. Both Verbal Reasoning and Numerical Ability are concerned with the acquisition of meaning from systems of symbols. The musical perception measures which relate to these aptitudes deal with a similar situation. Abstract Reasoning deals with the formation of expectations from a set of visual stimuli. Musical perception also results in the formation of expectations from sets of suditory stimuli. Syntax Ability is concerned with the arrangement or pattern of stimuli to form a meaningful sentence. The tests of musical perception which correlate with Syntax Ability also deal with the perception of a meaningful musical syntax.

Musical Response relates significantly with the same differential aptitudes that relate with Tonal-Rhythmic Memory and Tonal-Rhythmic Contour Perception. The measure of Musical Response was based upon the perception of meaningful wholes and the development of expectations based on present and past musical experiences. A comparison of this concept with the differential aptitude measures which relate significantly to Musical Response reveals similarities in the mode of these phenomena.

RECOMMENDATIONS

There is a need for further research into musical learning. More basic components of musical perception need to be isolated and identified in order to provide a more accurate profile of the perceptual process. These components should also be studied for relationships with various cognitive processes.

More study needs to be done in connection with the two sets of aptitudes which relate significantly to musical learning. Such research could result in the formation of distinctly separate approaches to different aspects of musical learning. A specialized musical learning theory would need to be developed from a multi-dimensional model.

Factors not considered in this study included sex, age, self-concept, and attitude. These and other factors may have been intervening factors of significant effect. This appears to be an area for further investigation.

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APPENDIX A

NUMBER________________ NAME________________________________

THIS TEST IS DIVIDED INTO FOUR SECTIONS. BEFORE EACH SECTION BEGINS, YOU WILL BE GIVEN DIRECTIONS ON HOW TO DO THAT SECTION. LISTEN CAREFULLY TO ALL DIRECTIONS. IF THERE IS ANYTHING YOU DO NOT UNDERSTAND BE SURE TO RAISE YOUR HAND.

THIS TEST WILL NOT AFFECT YOUR SCHOOL GRADES IN ANY WAY. YOU HAVE BEEN SELECTED TO HELP WITH THIS EXPERIMENT, SO PLEASE:

1. DO NOT TALK OR MAKE ANY SOUNDS WHILE BEING TESTED THAT WOULD TELL ANOTHER STUDENT HOW YOU HAVE ANSWERED A QUESTION.
2. DO NOT MAKE ANY FACIAL EXPRESSIONS THAT WOULD TELL ANOTHER STUDENT HOW YOU HAVE ANSWERED A QUESTION.
3. WATCH ONLY YOUR PAPER.

ALL OF THESE ARE VERY IMPORTANT FOR THIS TO BE A GOOD EXPERIMENT.

BEFORE WE GO ON TO THE NEXT PAGE, MAKE SURE YOU HAVE WRITTEN YOUR NAME AT THE TOP OF THIS PAPER.

QUIETLY TURN TO THE NEXT PAGE . . . SECTION NO. 1.

SECTION NO. 1

NUMBER ________________

(Listen carefully as the directions are given)

PRACTICE EX. A: Yes _____ No _____

PRACTICE EX. B: Yes _____ No _____

1. Yes _____ No _____
2. Yes _____ No _____
3. Yes _____ No _____
4. Yes _____ No _____
5. Yes _____ No _____
6. Yes _____ No _____
7. Yes _____ No _____
8. Yes _____ No _____
9. Yes _____ No _____
10. Yes _____ No _____
11. Yes _____ No _____
12. Yes _____ No _____
13. Yes _____ No _____
14. Yes _____ No _____
15. Yes _____ No _____
16. Yes _____ No _____
17. Yes _____ No _____
18. Yes _____ No _____
19. Yes _____ No _____
20. Yes _____ No _____

SECTION NO. 2

PRACTICE EX:

NOTE	RHYTHM	SAME
_____	_____	_____
_____	_____	_____

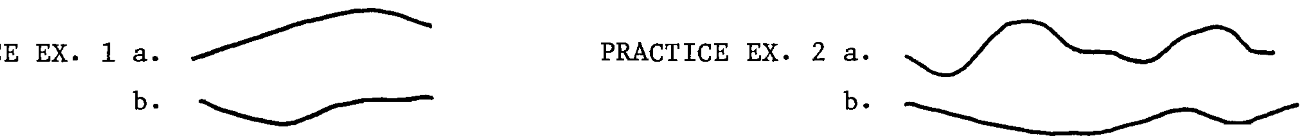
	NOTE	RHYTHM	SAME
1.	_____	_____	_____
	_____	_____	_____
2.	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
3.	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

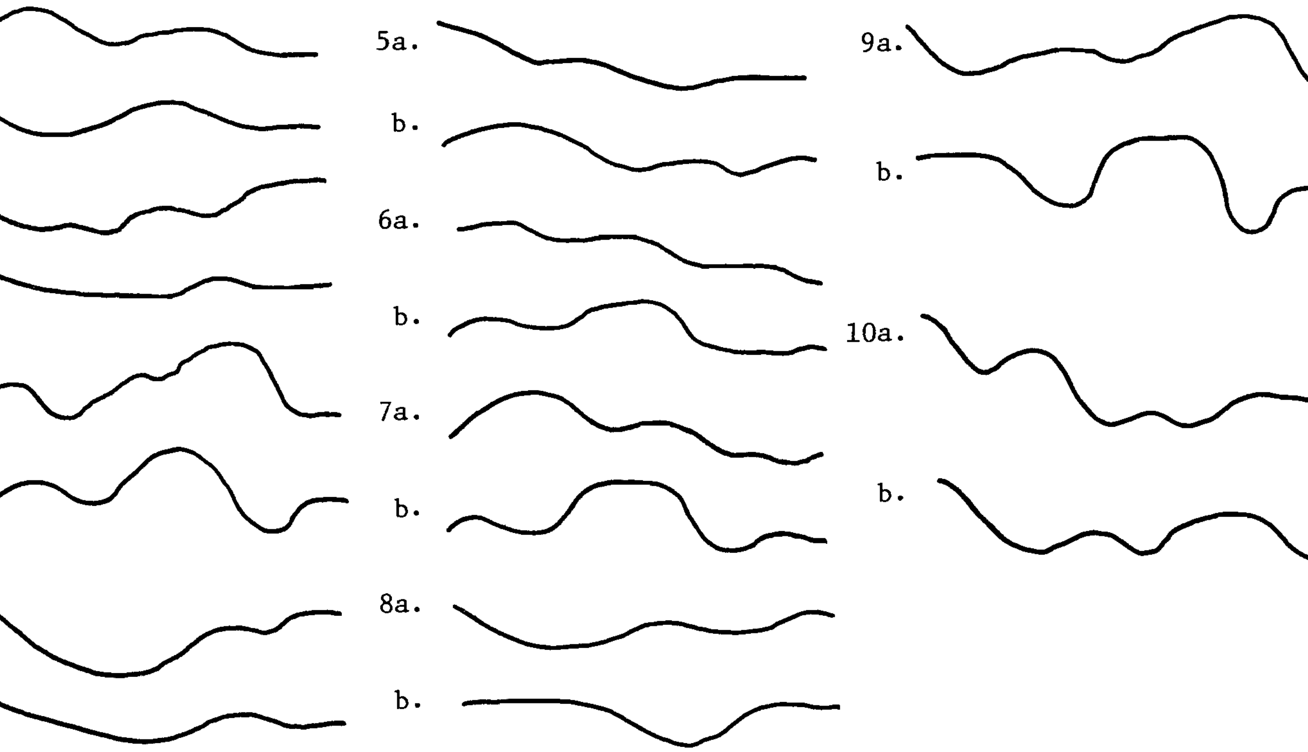
	NOTE	RHYTHM	SAME
4.	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
5.	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

	NOTE	RHYTHM	SAME
6.	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
7.	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

SECTION NO. 3

(Listen carefully as the directions are given)





SECTION NO. 4

CE EX. 1a.____
b.____

PRACTICE EX. 2a.____
b.____

8a.____
b.____

9a.____
b.____

10a.____
b.____

11a.____
b.____

12a.____
b.____

13a.____
b.____

14a.____
b.____

15a.____
b.____

16a.____
b.____

17a.____
b.____

18a.____
b.____

19a.____
b.____

20a.____
b.____

APPENDIX B

RAW DATA

ID NOS.	VARIABLES													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	10	50	18	8	11	90	75	85	85	85	80	70	80	75
2	13	91	22	5	13	60	45	55	70	65	95	95	45	55
3	11	62	10	3	10	35	15	15	20	5	50	55	50	15
4	11	80	13	4	12	45	25	30	15	10	20	50	15	35
5	11	61	22	9	10	55	95	80	95	70	95	80	30	65
6	9	54	6	6	10	15	50	30	25	70	65	50	50	25
7	12	90	15	6	18	30	70	50	40	70	50	30	50	35
8	9	62	16	7	11	45	80	60	70	90	75	50	75	65
9	13	75	21	6	14	60	60	60	85	25	50	55	85	55
10	13	79	19	7	14	50	85	70	95	55	85	75	40	70
11	10	62	20	5	12	45	30	35	40	25	30	35	30	55
12	18	115	20	9	18	99	97	99	99	60	99	99	97	97
13	14	84	22	4	15	45	45	40	40	20	15	45	40	70
14	7	36	12	6	8	60	70	65	60	65	85	35	70	50
15	14	79	17	4	15	40	45	40	10	55	55	20	55	35
16	11	67	14	5	11	55	20	40	10	80	20	30	65	60
17	14	79	15	9	12	95	90	95	95	75	85	70	85	40
18	15	86	19	7	15	95	75	90	75	80	65	95	90	75
19	13	83	19	7	16	90	25	70	85	45	90	35	3	65
20	10	65	11	3	12	10	40	15	25	5	75	45	50	40
21	17	102	19	7	11	55	65	60	80	55	65	95	25	65
22	12	61	15	3	13	15	55	30	35	10	35	1	30	35
23	13	73	14	4	12	20	30	15	60	55	50	60	10	30
24	10	44	16	6	9	55	60	55	55	35	65	35	75	65
25	10	63	15	6	9	45	30	30	20	60	70	65	50	55
26	10	50	11	3	9	15	35	20	20	55	25	60	10	15
27	15	98	16	7	15	75	75	75	95	55	85	75	55	80
28	10	59	18	3	14	15	50	25	20	65	20	50	20	55
29	10	69	15	5	11	5	55	25	65	35	25	15	35	15
30	11	65	18	3	15	40	30	30	45	75	90	40	25	30
31	10	74	9	2	13	10	10	3	5	35	40	25	50	20
32	12	68	17	2	12	10	20	10	25	50	40	50	5	15
33	11	79	11	8	15	95	95	95	65	75	70	1	85	85

RAW DATA

ID NOS.	VARIABLES 1	2	3	4	5	6	7	8	9	10	11	12	13	14
34	10	62	10	3	9	20	75	45	60	80	90	55	70	40
35	18	117	25	9	18	85	97	95	85	85	50	85	75	85
36	10	60	23	7	13	15	35	20	35	60	20	60	45	15
37	9	48	9	8	10	85	90	90	80	45	90	85	70	80
38	13	80	23	8	11	75	85	80	60	97	65	65	45	75
39	10	65	15	6	11	70	90	80	90	50	97	90	10	65
40	13	85	15	7	14	95	99	99	90	50	97	97	85	90
41	13	68	20	9	16	85	90	85	95	75	95	90	85	90
42	15	93	20	4	12	75	85	80	80	50	50	85	75	75
43	10	66	8	8	10	35	60	45	65	45	65	35	40	25
44	14	76	13	7	14	45	55	45	40	55	40	30	65	45
45	10	65	22	5	12	35	85	65	35	80	70	80	75	50
46	11	71	17	7	12	80	90	85	90	97	95	70	95	90
47	17	109	20	6	16	97	97	97	90	90	97	90	95	95
48	13	76	20	8	13	40	65	50	40	75	65	25	80	55
49	11	56	13	7	12	5	75	40	60	75	5	25	55	60
50	13	78	17	6	18	85	97	95	95	60	95	95	85	85
51	9	63	21	5	11	97	99	99	99	55	99	97	85	90
52	10	60	15	5	14	85	95	90	75	75	70	85	75	55
53	15	91	19	8	16	35	45	35	85	55	95	35	15	15
54	11	72	13	4	10	50	55	50	70	30	45	80	30	45
55	13	78	17	6	15	65	55	60	45	20	70	55	15	65
56	16	100	21	8	18	50	90	75	60	70	75	65	65	85
57	10	70	8	7	13	40	25	25	15	15	85	35	10	65
58	13	76	20	3	14	25	15	15	15	45	35	55	60	50
59	9	57	17	7	17	75	60	70	50	25	65	5	95	95
60	10	56	16	4	10	75	25	55	55	45	90	95	60	50
61	15	99	25	6	11	97	99	99	99	75	95	99	80	95
62	14	83	17	5	9	50	85	65	60	70	65	40	30	60
63	9	45	16	5	14	50	70	60	80	50	90	40	55	55
64	13	71	14	5	6	55	55	50	60	20	95	80	10	45
65	9	56	6	3	15	30	55	40	40	80	45	30	50	35
66	9	47	12	3	13	25	30	20	25	10	45	5	5	25

APPENDIX C

SIMPLE CORRELATIONS

	CTP 1	CTP 2	TRM 3	TRCP 4	MRT 5	VR 6	NA 7
CTP	1.0000	0.9118	0.5388	0.3297	0.4741	0.3628	0.2858
CTP	0.9118	1.0000	0.4846	0.3055	0.5245	0.3682	0.2847
TRM	0.5388	0.4846	1.0000	0.2951	0.3301	0.3707	0.3090
TRCP	0.3297	0.3055	0.2951	1.0000	0.2331	0.5594	0.5937
MRT	0.4741	0.5245	0.3301	0.2331	1.0000	0.2305	0.1671
VR	0.3628	0.3682	0.3707	0.5594	0.2305	1.0000	0.6181
NA	0.2858	0.2847	0.3090	0.5937	0.1671	0.6181	1.0000
V/N	0.3598	0.3628	0.3990	0.6511	0.2380	0.9081	0.8780
AR	0.3678	0.3390	0.3952	0.6011	0.1566	0.7070	0.7695
SR	0.1787	0.1841	0.2762	0.4042	0.1136	0.3036	0.5307
MR	0.1299	0.1565	0.1270	0.4180	0.0321	0.6135	0.5014
CSA	0.3742	0.3629	0.4040	0.2441	-0.0470	0.5613	0.4649
SA	0.1439	0.1500	0.2071	0.3898	0.2363	0.5526	0.5841
SS	0.3597	0.3781	0.4422	0.5409	0.3123	0.7922	0.6823
$\bar{X}$ =	11.9	72.2	16.2	5.7	12.8	53.1	61.7
s =	2.4	16.9	4.5	1.9	2.7	27.8	26.4

SIMPLE CORRELATIONS, CONT.

	V/N 8	AR 9	SR 10	MR 11	CSA 12	SA 13	SS 14
CTP	0.3588	0.3678	0.1787	0.1289	0.3742	0.1439	0.3597
CTP	0.3628	0.3390	0.1841	0.1565	0.3629	0.1500	0.3781
TRM	0.3990	0.3952	0.2762	0.1270	0.4040	0.2071	0.4422
TRCP	0.6511	0.6011	0.4042	0.4180	0.2441	0.3898	0.5409
MRT	0.2380	0.1566	0.1136	0.0321	-0.0470	0.2363	0.3123
VR	0.9081	0.7070	0.3036	0.6135	0.5613	0.5526	0.7922
NA	0.8780	0.7695	0.5307	0.5014	0.4649	0.5841	0.6823
V/N	1.0000	0.8213	0.4757	0.6181	0.5687	0.6238	0.8210
AR	0.8213	1.0000	0.3591	0.6411	0.5798	0.3896	0.6014
SR	0.4757	0.3591	1.0000	0.2565	0.2906	0.4533	0.3203
MR	0.6181	0.6411	0.2565	1.0000	0.4985	0.2885	0.4665
CSA	0.5687	0.5798	0.2906	0.4985	1.0000	0.2711	0.4612
SA	0.6238	0.3896	0.4533	0.2885	0.2711	1.0000	0.5822
SS	0.8210	0.6014	0.3203	0.4665	0.4612	0.5822	1.0000
$\bar{X}$ =	56.1	58.4	54.9	65.4	56.9	52.6	56.0
s =	27.4	27.8	23.7	25.8	27.4	27.3	23.7

APPENDIX D

****

VAR.NO.	B-WEIGHT	Z-WEIGHT
2	0.1189982891	C.8291
3	0.0659535527	0.1211
4	0.0868256092	0.0689
5	0.0031832522	0.0035
6	0.0234582573	0.2690
7	0.0174741112	0.1900
8	-0.0387508497	-0.4374
9	0.0078935623	0.0905
10	-0.0013084947	-0.0128
11	-0.0075295977	-0.0800
12	0.0031271020	0.0353
13	-0.0002362341	-0.0027
14	-0.0058588423	-0.0572

CONSTANT = 1.7945

MULTPL-R = 0.9239
R-SQUARE = 0.8536

****
****

REGRESSION EQUATION NO. 2 CRITERION IS VAR. NO. 2

****

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	5.8933763504	0.8458
3	-0.1725552678	-0.0455
4	-0.1869501472	-0.0213
5	0.8975933194	0.1425
6	0.0104349256	0.0172
7	0.0198503025	0.0310
8	0.0020325519	0.0033
9	-0.0478347130	-0.0787
10	0.0171156824	0.0240
11	0.0225693733	0.0344
12	0.0398220532	0.0644
13	-0.0328848921	-0.0531
14	0.0345607921	0.0484

CONSTANT = -9.3909

MULTPL-R = 0.9223
R-SQUARE = 0.8506

****
****

REGRESSION EQUATION NO. 3 CRITERION IS VAR. NO. 3

****

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	0.8160192370	0.4443
2	-0.0431085937	-0.1635
4	-0.0554231666	-0.0240
5	0.1831720471	0.1103
6	-0.1196299791	-0.7470
7	-0.1293305755	-0.7657
8	0.1789767742	1.1000
9	0.0401600376	0.2508
10	0.0257163532	0.1368
11	-0.0333060957	-0.1927
12	0.0353587642	0.2171
13	-0.0073299520	-0.0449
14	0.0668701530	0.3552

CONSTANT = 4.9929

MULTPL-R = 0.6803

****

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	0.1819810867	0.2293
2	-0.0079118907	-0.0695
3	-0.0093887895	-0.0217
5	-0.0217671730	-0.0303
6	-0.0193909146	-0.2802
7	-0.0184038170	-0.2521
8	0.0580263771	0.8251
9	0.0187530369	0.2709
10	0.0122580267	0.1509
11	0.0055203512	0.0739
12	-0.0205605812	-0.2920
13	-0.0014364794	-0.0204
14	0.0098532736	0.1211
CONSTANT =	2.0437	

MULTPL-R = 0.7161
R-SQUARE = 0.5128

****
****
REGRESSION EQUATION NO. 5 CRITERION IS VAR. NO. 5
****

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	0.0148553848	0.0134
2	0.0845765471	0.5327
3	0.0690861344	0.1147
4	-0.0484637171	-0.0348
6	-0.0646613836	-0.6703
7	-0.0660380721	-0.6490
8	0.1117246151	1.1399
9	0.0039736181	0.0412
10	-0.0048701391	-0.0430
11	0.0039034428	0.0375
12	-0.0402161777	-0.4098
13	0.0189810954	0.1932
14	0.0181722678	0.1602
CONSTANT =	6.9298	

MULTPL-R = 0.6645
R-SQUARE = 0.4416

****
****
REGRESSION EQUATION NO. 6 CRITERION IS VAR. NO. 6
****

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	0.5875746012	0.0512
2	0.0052767359	0.0032
3	-0.2421829700	-0.0388
4	-0.2317280173	-0.0160
5	-0.3470686078	-0.0335
7	-0.7894532084	-0.7484
8	1.5377197266	1.5134
9	-0.0087425560	-0.0087
10	-0.0636995435	-0.0543
11	0.0375116691	0.0348
12	0.0143265091	0.0141
13	0.0453379937	0.0445
14	0.0600277707	0.0511
CONSTANT =	12.9431	

MULTPL-R = 0.9860

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	0.5537903309	0.0509
2	0.0127019510	0.0081
3	-0.3312721848	-0.0560
4	-0.2782751918	-0.0203
5	-0.4484836459	-0.0456
6	-0.9988644719	-1.0536
8	1.6838712692	1.7480
9	0.0437755696	0.0462
10	-0.0279803760	-0.0251
11	0.0129505955	0.0127
12	0.0005566119	0.0006
13	0.0555627085	0.0575
14	0.0569130033	0.0511

CONSTANT = 17.5587

MULTPL-R = 0.9802
R-SQUARE = 0.9607

REGRESSION EQUATION NO. 8 CRITERION IS VAR. NO. 8

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	-0.3601571321	-0.0319
2	0.0003817803	0.0002
3	0.1344445348	0.0219
4	0.2573084235	0.0181
5	0.2225168943	0.0218
6	0.5705860257	0.5798
7	0.4938225746	0.4757
9	0.0294095613	0.0299
10	0.0382427461	0.0331
11	-0.0104845762	-0.0099
12	0.0007777545	0.0008
13	-0.0142856315	-0.0143
14	0.0071828365	0.0062

CONSTANT = -9.7876

MULTPL-R = 0.9946
R-SQUARE = 0.9893

REGRESSION EQUATION NO. 9 CRITERION IS VAR. NO. 9

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	1.5541725159	0.1355
2	-0.1901718378	-0.1155
3	0.6390805840	0.1023
4	1.7616415024	0.1219
5	0.1676596999	0.0162
6	-0.0687193274	-0.0687
7	0.2719670534	0.2579
8	0.6230199337	0.6132
10	-0.1236887574	-0.1054
11	0.2169869542	0.2011
12	0.1237730384	0.1217
13	-0.1102900505	-0.1083
14	-0.2326968908	-0.1979

CONSTANT = -12.6567

MULTPL-R = 0.8836

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	-0.4875632524	-0.0499
2	0.1287745237	0.0918
3	0.7744843364	0.1456
4	2.1792402267	0.1771
5	-0.3883735175	-0.0440
6	-0.9476142526	-1.1124
7	-0.3289764524	-0.3661
8	1.5332098007	1.7714
9	-0.2340834737	-0.2748
11	0.0782096982	0.0851
12	0.1032596231	0.1192
13	0.2458690405	0.2834
14	-0.2607977390	-0.2604
CONSTANT =	20.3245	

MULTPL-R = 0.6544
R-SQUARE = 0.4282

REGRESSION EQUATION NO. 11 CRITERION IS VAR. NO. 11

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	-2.7086753845	-0.2549
2	0.1639391184	0.1075
3	-0.9683803320	-0.1674
4	0.9474832416	0.0708
5	0.3009082675	0.0313
6	0.5387446880	0.5815
7	0.1470007896	0.1504
8	-0.4058126211	-0.4311
9	0.3964541554	0.4279
10	0.0755059123	0.0694
12	0.1943452954	0.2062
13	-0.0885102749	-0.0938
14	0.0153725185	0.0141
CONSTANT =	42.6927	

MULTPL-R = 0.7303
R-SQUARE = 0.5334

REGRESSION EQUATION NO. 12 CRITERION IS VAR. NO. 12

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	1.1914129257	0.1057
2	0.3063531518	0.1893
3	1.0883233185	0.1774
4	-3.7374744415	-0.2631
5	-3.2834415436	-0.3222
6	0.2179206610	0.2217
7	0.0065927075	0.0065
8	0.0318803489	0.0319
9	0.2395098209	0.2436
10	0.1055818200	0.0915
11	0.2058315873	0.1940
13	0.0084026381	0.0084
14	0.0446374462	0.0387
CONSTANT =	16.2736	

MULTPL-R = 0.7490

REGRESSION EQUATION NO. 13 CRITERION IS VAR. NO. 13

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	-0.0979286432	-0.0087
2	-0.2752296329	-0.1703
3	-0.2455649376	-0.0400
4	-0.2840821743	-0.0200
5	1.6859788895	0.1656
6	0.7502732873	0.7641
7	0.7267090678	0.7017
8	-0.6371116638	-0.6386
9	-0.2321848869	-0.2365
10	0.2735046744	0.2373
11	-0.1019846201	-0.0962
12	0.0091417842	0.0092
14	0.2004206777	0.1736
CONSTANT =	2.1787	

MULTPL-R = 0.7220
R-SQUARE = 0.5213

REGRESSION EQUATION NO. 14 CRITERION IS VAR. NO. 14

VAR.NO.	B-WEIGHT	Z-WEIGHT
1	-0.9785840511	-0.1003
2	0.1165592074	0.0833
3	0.9027323127	0.1700
4	0.7852202654	0.0639
5	0.6504361629	0.0738
6	0.4002920389	0.4706
7	0.2999536991	0.3343
8	0.1290830374	0.1494
9	-0.1974034905	-0.2321
10	-0.1169036031	-0.1171
11	0.0071374848	0.0078
12	0.0195907690	0.0226
13	0.0807619691	0.0932
CONSTANT =	-3.1345	

MULTPL-R = 0.8619
R-SQUARE = 0.7430

APPENDIX E

EMPORIA KANSAS STATE COLLEGE
1200 COMMERCIAL / EMPORIA, KANSAS 66801 / TELEPHONE (316) 343-1200

December 8, 1976

Mr. Dan Neuenswander, Superintendent
USD 290
420 S. Main Box 583
Ottawa, KS 66067

Dear Mr. Neuenswander:

I am currently working toward a Masters degree in Music at Emporia Kansas State College. In partial fulfillment of the requirements I have elected to write a thesis entitled "A Study of the Interrelationships of Musical Perception, Musical Response, and Differential Aptitude." A prospectus for this study is enclosed.

In order for me to carry out this study, I must test between fifty and one-hundred music students. The testing period would take one hour. Along with the results from these assessments, I would also need to secure scores received by the same students on the Differential Aptitude Test Battery. All scores would, of course, be coded so that they would all remain anonymous. All findings would be made available to your school system.

If it is convenient for you, I would like to test the students sometime between the 3rd and the 19th of January. However, if this is not possible, anytime early in 1977 would be fine.

I believe strongly in the relevance and timeliness of this study and will appreciate your consideration. Thank you very much.

Sincerely,

Robert E. Fisher
Beach Music Hall
Emporia Kansas State College
Emporia, Kansas 66801