AN INVESTIGATION OF DIFFERENCES IN MUSICAL ACHIEVEMENT BETWEEN NEUROLOGICALLY IMPAIRED CHILDREN AND NORMAL CHILDREN

Submitted to the Temple University Graduate Board
in Partial Fulfillment of the Requirements
for the Degree of
Doctor of Philosophy

By

Sister Jean Anthony Gileno, IHM

April, 1986

FORM IV

TEMPLE UNIVERSITY GRADUATE BOARD

Title of Dissertation: An Investigation of Differences In Musical Achievement Between Neurologically Impaired Children and Normal Children

Author: Sister Jean Anthony Gileno, I.H.M.

Read and Approved by: .....

.....

.....

.....

.....

.....

Date submitted to Graduate Board: ..... April 11, 1986 .....

Accepted by the Graduate Board of Temple University in partial fulfillment of the requirements for the degree of **Doctor of Philosophy**.

Date ..... 6/6/86 .....

.....
(Dean of Graduate School)

ACKNOWLEDGEMENTS

The author extends her gratitude to all of the members of her congregation of Sisters, Servants of the Immaculate Heart of Mary, who have supported her in this research.

Appreciation is extended to Dr. Edwin E. Gordon, my advisor, and to Dr. John Holahan for their guidance and consultation in the development of this study. Gratitude is extended to Dr. Roger Dean, Dr. Stimson Carrow and Dr. Eve Meyer for their interest and encouragement in this research.

Appreciation is also extended to Dr. David Long, Neurologist, Bryn Mawr Rehabilitation Hospital, Malvern, Pennsylvania; Dr. Peter Berman and Dr. Gerard Trombley of the Children's Hospital, Department of Child Neurology, Philadelphia, Pennsylvania; and to Dr. Douglas Spencer, Chairman of Developmental Medicine, Alfred I. Dupont Institute, Wilmington, Delaware for their guidance about aspects of neurology.

Gratitude is extended to superintendents Benjamin Champion, Paul Krentel, Sister Angela McGinnis, Patricia Hoey; to principals Sister James Margaret Haines, James Waskovich, and George Murphy; to instructors John Broomall, Lynn Reeder, Maria DiBenedetto, Paul Iaboni, Carol Capperella, Joanne McAdams, and Anita Egan for facilitating the administration of the rating scales.

TABLE OF CONTENTS

CHAPTER ONE

PURPOSE OF THE STUDY

Introduction

Since the early 1970's, the topic of mainstreaming has been one of interest as well as concern to music educators in the public schools. Mainstreaming provides children who are learning disabled, physically handicapped, neurologically impaired, and developmentally delayed with the opportunity of participating in music programs with normal children.[1] Neurologically impaired children constitute a large number of mainstreamed children. Although those children have been classified as learning disabled, developmentally delayed, or learning impaired, they are nonetheless, neurologically impaired.[2]

Music educators confronted with the problem of teaching neurologically impaired children in the mainstreamed classroom have been given the responsibility of integrating music instruction for neurologically impaired

---

[1]Cecil D. Mercer, Children and Adolescents with Learning Disabilities. (Ohio: Charles E. Merrill Co., 1979), pp.320-331.

[2]Donald E. Michel, Music Therapy. (Illinois: Charles C. Thomas Press, 1976), pp.61-64.

children with that of music instruction for normal children. That type of instruction demands the formulation of objectives, the selection of materials, and the development of methods and techniques which will foster musical achievement of neurologically impaired children as well as that of normal children. As an alternative, many music educators have merged special education music activities with general music curricula, thus providing instruction for all children as a "mainstreamed" class. Although beneficial with respect to meeting special educational objectives and encouraging normal children to share music learning experiences with neurologically impaired children, the quality of and extent to which both groups of children have benefited from such instruction should be evaluated through descriptive and investigative research. Such research would not only provide information about individual differences in musical achievement which exist among neurologically impaired children, but it should also provide information about individual differences in musical achievement which exist between neurologically impaired children and normal children.

Musical achievement of normal children has been described by music psychologists as the ability to perform given musical tasks ordered according to difficulty levels with some degree of accuracy. Those degrees of accuracy, when compiled, scored, and used as objective measures, are

known as achievement levels.[3]

Musical achievement levels vary with each child, depending upon age and musical aptitude.[4] Very young children usually perform musical tasks which are creative and improvisational in nature, while older children, in addition to performing tasks which are creative and improvisational, perform tasks which are structured and require higher levels of conceptualization. Thus individual differences in musical achievement exist among normal children, and knowledge of those differences has been useful in determining to what extent their skill in musical performance may be achieved.

Neurologists have described the musical achievement of neurologically impaired children in terms of causes related to specific neurological impairments.5 Music psychologists, on the other hand, have not expanded descriptions of musical achievement of children to include that of the neurologically impaired.[6] Reasons for

---

[3]Richard Colwell, The Evaluation of Music Teaching and Learning. (New Jersey: Prentice Hall, 1970), p.97.

[4]Edwin E. Gordon, Primary Measures of Music Audiation. (Chicago: G.I.A. Publications Inc., 1979), p.4.

[5]A. Gates and J. L. Bradshaw, "The Role of Cerebral Hemispheres in Music." Brain and Language, Vol.4 (1977), p.416.

[6]Rudolf Radocy and David Boyle, Psychological Foundations of Musical Behavior. (Illinois: Charles C. Thomas Press, 1976), pp.288-290.

this sparsity of descriptive research lie in the fact that little is known about the neurological aspects of musical achievement, such as receptive/reactive behavior, the compensatory functions of the process of synapses, and plasticity.

Receptive/reactive behavior denotes the interactive processes between cells within the central nervous system which cause children to react to specific tonal or rhythm stimuli. Such reactions are initiated when sounds enter the ear and are received by the brain.[7] That type of musical behavior may be described as (1) gnosic (receptive), the child's ability to recognize the significance of tonal and rhythm patterns, and (2) praxic (productive), the child's ability to perform them with some degree of accuracy.

Many complex components include receptive/reactive behaviors, some of which are congenital and others of which are acquired. The term "acquired" implies achievement, that is, the achievement of learning skills such as writing, speaking, moving, and overall coordination of gross and fine motor skills.[8] Similarly, musical achievement of children

---

[7]Robert F. Schmidt, Fundamentals of Neurophysiology. (New York: Springer-Verlag Publications, 1975), pp.114-127.

[8]Cecil D. Mercer, Children and Adolescents with Learning Disabilities. (Ohio: Charles E. Merrill Co., 1979), pp.124-140.

includes receptive/reactive behaviors which facilitate the performance of vocal and instrumental sounds. They require accurate perception (receptive), processing by brain circuitry, precise coordinated motor responses (reactive), and the acquisition of musical skills.[9]

Depending upon difficulty levels of given musical stimuli, musical achievement levels of normal children may be evaluated through the use of criterion measures such as rating scales. Musical achievement levels of neurologically impaired children, however, are not always evaluated through the use of rating scales. Rather, information about causes related to specific neurological impairments is used.[10] Thus receptive/reactive behaviors (musical achievement) may be found to vary considerably between groups of neurologically impaired children and normal children depending upon the difficulty levels of given musical stimuli and the criteria used to evaluate musical achievement.

Smaller divisions of the receptive/reactive component of the central nervous system involve the process of synapses. Synapses are regions of communication between

---

[9]Edwin E. Gordon, Learning Sequences in Music: Skill, Content, and Patterns. (Chicago: G.I.A. Publications Inc., 1984), pp.134-166.

[10]S. Blumstein, "Hemispheric Processing of Intonation Contours." Cortex, Vol.10 (1974), p.147.

nerve cells, points at which nerve cells pass from one to the other. Synapses follow circuitry plans which are comparable to advanced computerized equipment. Brain circuitry is complex and many parts of the brain are needed for musical achievement including both cerebral hemispheres, the brain stem, and the cerebellum. The cerebellum (the back portion of the brain which controls muscular coordination and equilibrium) calculates the flow of parts and materials during the process of synapses. At the final assembly stage, components come together with flawless precision.

The achievement of complex musical responses by children requires total integration of receptive/reactive processes, so that responses to musical stimuli may be complete.[11] Musical responses which are incomplete or have not been fully processed through the brain may be attributed to deficits in the process of synapses. Fortunately, compensation for such deficits may be possible. That compensatory function is known as plasticity.

Two medical doctors, Peter Berman and David Long, have described those portions of the brain which are not affected by lesional or organic deterioration as compensatory because they function for parts

---

[11]Donald G. Stein, Basic Structure and Function in the Central Nervous System. (New York: Macmillan

of the brain which have been damaged.[12] That is true particularly during children's developmental stages, ages six through eleven and possibly younger, when their learning, memory, and conceptual abilities are developed through education.[13]

In some instances, neurological examinations of children with damage to the left side of the brain have revealed that they were able to speak as well as to retain information, despite those deficits. Further, examinations of children with damage to the right side of the brain have revealed normal functioning, although certain deficits were present. It may be possible to establish that the musical achievement of neurologically impaired children parallels those analyses.

Individual differences in musical achievement of all children should depend upon the skill levels they already have achieved and those which they have the potential to achieve. Because of the inseparable relationship between the central nervous system and the process of learning, knowledge of differences in musical achievement among

---

[12]Peter Berman, M.D., Chief of Child Neurology, Department of Neurology, The Children's Hospital, University of Pennsylvania, Philadelphia, Pa. 19102. Interview, May 15, 1984.

[13]David Long, M.D., Neurologist, Bryn Mawr Rehabilitation Hospital, Malvern, Pennsylvania, 19355. Interview, September 26, 1985.

various populations of children is essential in establishing programs to foster musical development. The purpose of this study, therefore, is to gain knowledge about differences in musical achievement that may exist between neurologically impaired children and normal children.

Problems

The problems of the study are the following:

1. To compare the tonal performance achievement of neurologically impaired children and normal children

2. To compare the rhythm performance achievement of neurologically impaired children and normal children

CHAPTER TWO

RELATED STUDIES

Introduction

During the past decade, research has emerged in the disciplines of neurology and music psychology. It has contributed to knowledge about differences in musical achievement which may exist between neurologically impaired persons and normal persons. Three studies that are most relevant to the present study are described below.

Auditory Sequencing and Left Cerebral Dominance for Language

Albert conducted an investigation of auditory sequencing.[14] The specific problem of his study was to investigate differences in the ability to maintain and use sequential aspects of acoustic input between neurologically impaired persons and normal persons.

Seventy-five neurologically impaired persons and 30 normal persons were selected to participate in the investigation. An auditory sequencing test was administered

---

[14]Martin L. Albert, "Auditory Sequencing and Left Cerebral Dominance for Language." Neuropsychologia, Vol.10 (1972), pp.245-248.

individually to each participant by an examiner.

The examiner sat opposite the person to be tested, with a table between them. Twenty common objects were spread on the table. The person was instructed to listen to each recorded command and then to point to one of two objects in a specified order. When the person failed to fulfill a given command three times, he was instructed to proceed to the next command. That procedure was followed until the auditory sequencing test was completed. The highest number of commands achieved by a person represented his total score.

On the basis of the data gathered from the study, it was determined that there are significant differences in auditory sequencing between the neurologically impaired persons and normal persons, and that the normal persons score higher than neurologically impaired persons in auditory sequencing. The conclusion drawn was that the development of language is primarily based upon auditory mechanisms rather than upon those which are tactile and visual in nature.

Toward a Neuromusicology: The Effects of Brain Damage on Music Reading and Musical Creativity

Judd investigated changes in the musical behavior of persons with neurological impairments.[15] He generalized that

acquired information to the musical behavior of normal persons. The problems of his study were to investigate changes in a neurologically impaired person's ability (1) to sing, (2) to perceive and to memorize sounds, (3) to reproduce rhythm patterns, and (4) to respond to a variety of musical stimuli.

One neurologically impaired adult and two normal adults were selected to participate in the investigation. Tonal and rhythm tests, based upon the ideas and suggestions of Jellinek,[16] Ustvedt,[17] Wertheim,[18] Seashore,[19] Deutsch,[20] Colwell[21] were constructed by the investigator.

---

[15]Theodore L. Judd, "Toward a Neuromusicology: The Effects of Brain Damage on Music Reading and Musical Creativity." Ph.D. Thesis, Cornell University, August, 1979.

[16]A. Jellinek, "Zur Phänomenologie Amusie." Psychiatrie und Neurologie., Vol.50 (1933), p.120.

[17]H.J. Ustvedt, "Ueber die Untersuchung der musikalischen Funktionen bei Patienten mit Aphasie." Acta Neurologica Scandinavica. (1937), Supp.86-94.

[18]N. Wertheim, "Disturbances of the Musical Functions." In Problems of Dynamic Neurology. L. Halpern, ed. (Jerusalem: Rothschild Hadassah University Hospital, 1963), pp.47-59.

[19]Carl Seashore, The Psychology of Music. (New York: McGraw-Hill Press, 1938), pp.268-272.

[20]Diana Deutsch, "Music Recognition." Psychological Review, Vol.76 (1969), pp.300-307.

[21]Richard Colwell, The Evaluation of Music Teaching and Learning. (New Jersey: Prentice Hall, 1970), pp.111-130.

The following tests with directions were administered individually.

(1)Pitch Discrimination

Listen to each recorded pitch and then indicate on the test form which pitch was high and which was low.

(2)Timbre Discrimination

Listen to each two-note recorded set of pitches and then indicate on the test form which of the two pitches was high and which was low.

(3)Instrument Identification

Listen to each recorded excerpt of solo instruments and then verbally identify the instrument that is heard.

(4)Melodic Writing

Write a familiar melody.

(5)Melodic Dictation

Listen to each recorded melody and then write what was heard.

(6)Ear Training

Listen to each recorded chord progression and then write what was heard.

(7)Musical Analysis

Analyze a composition by Mozart.

(8)Music Reading

Read each excerpt of music and then verbally identify

what was read.

(9)Long Term Musical Memory

Listen to each recorded musical composition and then identify the composer and style period.

(10)Short Term Musical Memory

Listen to each series of recorded pitch sequences, rhythms, and melodies, and then sing what was heard.

(11)Dichotic Listening

Listen to each set of spoken dichotic digits, and then identify the ear in which each set of digits was heard.

(12)Musical Scale Illusion

Listen to two recorded scales presented dichotically, and then verbally identify the ear in which each scale was heard.

(13)Improvisation

Improvise at the piano.

(14)Composition

Write a composition in the style of Mozart and a short canon in the style of Bach.

(15)Rhythm Repetition

Listen to each short rhythm sequence and then tap on the table what was heard.

(16)Discrimination of Dynamics

Listen to each two-note set of recorded pitches and then indicate on the test form which of the two pitches was loud and which was soft.

(17)Discrimination of Duration

Listen to each recorded pitch and then indicate on the test form which pitch was short and which was long.

(18)Rhythm Discrimination

Listen to each pair of rhythm patterns and then indicate on the test form whether the patterns were the same or different.

(19)Rhythm Dictation

Listen to each rhythm pattern and then notate what was heard.

(20)Melodic Rhythm

Listen to each pair of melodic rhythm patterns and then indicate on the test form whether the patterns were the same or different.

(21)Rhythm Analysis

Listen to each short melody and then verbally identify the meter.

(22)Rhythm Reading

Read each rhythm pattern and then repeat the rhythm pattern by finger snapping.

(23)Meter Discrimination

Read each excerpt of music and then supply the missing time signature.

On the basis of the data gathered from the study it was determined that changes which occur as a result of a person's neurological impairments are as follows: (1) deficits in singing, (2) deficits in auditory perception and