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THE EFFECTS OF AUDITORY-VISUAL AND VISUAL
STIMULI ON IMITATIVE SENSORIMOTOR
RESPONSES IN AUTISTIC CHILDREN

presented by

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of the requirements for

MASTER OF MUSIC degree in MUSIC THERAPY

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THE EFFECTS OF AUDITORY-VISUAL AND VISUAL STIMULI
ON IMITATIVE SENSORIMOTOR RESPONSES
IN AUTISTIC CHILDREN

by

Kathleen K. Sun, RMT

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF MUSIC, MUSIC THERAPY

School of Music

1985

ABSTRACT

THE EFFECTS OF AUDITORY-VISUAL AND VISUAL STIMULI ON IMITATIVE SENSORIMOTOR RESPONSES IN AUTISTIC CHILDREN

By

Kathleen K. Sun

The purpose of this study was to examine the effects of auditory-visual and visual stimuli on imitative sensorimotor responses in autistic children.

Each of twenty-five subjects was assigned to one of two testing conditions in which they were asked to imitate five tasks. In the auditory-visual condition, subjects were presented with both the visual stimuli (experimenter playing the instruments) and the auditory stimuli (musical sound produced from playing the instruments). In the visual condition, subjects were presented with the visual stimuli alone. Accuracy in imitation was evaluated in tempo and number of motions.

A statistically significant difference was found between the two groups of subjects in their imitation of number of motions. The auditory-visual group scored higher. No statistically significant difference was found between the two groups in their imitation of tempo, nor between results of subjects who had previous music-related contact with the experimenter and those who had not.

ACKNOWLEDGEMENTS

The author wishes to express her appreciation and gratitude to Professor Robert Unkefer and Dr. Dale Bartlett for their help, guidance and support throughout this research study.

Grateful appreciation is also extended to Thomas Cawood, Mary Ellen Hicks, Karen Moiser and Benjamin Sun for individual help and contributions.

A very special thank-you is given to the students and teachers at the Center for Autism, Genesee Intermediate School District in Flint, Michigan, for their cooperation and participation in this study.

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CHAPTER I

THE PROBLEM

Introduction

In 1943, Leo Kanner, a child psychiatrist, brought to the attention of clinicians a group of severely disturbed children whom he described as "autistic". Ever since his initial employment of the word "autism", a number of children have been found to share the unique characteristics of this syndrome. Essentially these children have been found to be aloof, unwilling to establish contact with people, and inadequate in communication skills. Very often the cognitive potentialities of these children are masked by these characteristics, making treatment extremely difficult.

The emotional isolation of autistic children has also been proved to be a barrier in their process of learning, and consequently in their adaptation to community life. In order to work with them effectively, a treatment strategy maximizing their responses and their contact with reality must be utilized.

Purpose of the Study

The purpose of this study was to examine the effects of auditory-visual and visual stimuli on imitative sensorimotor

responses in autistic children. In particular, the intention was to identify the testing condition, auditory-visual or visual, under which imitative responses would be more accurate in terms of tempo and number of motions. This study was also aimed to identify whether there is a difference in performance between the autistic children who had prior contact with the experimenter through participation in music therapy sessions for six months and those who had not.

Need for the study

Research has indicated that autistic children tend to display stronger responses to certain stimuli and weaker responses to others. For example, an autistic child may respond strongly to tactile stimuli while at the same time neglect verbal instructions of an experimenter. This overselective behavior has been found consistently in autistic individuals regarding different types of stimuli. While the reduction of overselectivity remains a difficult task, it may be beneficial to make use of this "unusual characteristic" in a positive way. For if certain stimuli are found to facilitate responses more than others in a learning situation, these stimuli can be recommended as better means of establishing contact with autistic children; and application of this insight prior to therapeutic intervention may prove to be clinically valuable. Since there has not been any published study done in this area, the present study was aimed to evaluate effectiveness of two

types of stimuli, auditory (music)-visual and visual, in the learning of imitative skills in autistic children.

Imitative ability has been identified as an important factor in learning adaptational skills and a foundation for more complex behaviors (Lovaas, et al., 1967). Research has also indicated that imitative skills of autistic children are very poor (Ritvo and Provence, 1953; Curcio, 1978; Jones and Prior, 1985). However, research in this area has been limited only to reporting what autistic children can or cannot do. What the research lacks are methods and strategies that would facilitate learning of imitative skills in autistic children. This study was intended to bring a link between studies on stimuli preference and studies on imitative abilities.

There are numerous references to the attractiveness of music for autistic children both in the literature (Rimland, 1964; Provonost, 1961; Sherwin, 1953) and in subjective observation by parents and clinicians. However, this "unique reaction to music" observation can only be proved empirically and evaluated through experimental research. This study was also intended to determine if, in practice, there is a preference for musical sound in autistic children. The results of this study may reinforce the use of music as an effective tool in the treatment of autistic children. Such knowledge provides a basis for decisions concerning the choice of activities to be used with autistic individuals.

Research Questions

1. Is there a statistically significant difference in the accuracy of tempo between the auditory-visual and the visual groups?
2. Is there a statistically significant difference in the accuracy of number of motions between the auditory-visual and the visual groups?
3. Do the scores of the individuals who had previous contact with the experimenter through participation in music therapy sessions differ from the scores of those who have not?

Definition of terms

- Sensory modalities : the five faculties that receive impressions through specific bodily organs -- sight, touch, taste, smell and hearing.
- Sensorimotor response : motor responses that are initiated by sensory stimulation.
- Stimulus : any action or agent that initiates an activity in an organism.
- Body-object imitation : imitation of movements that the model makes with an object, e.g., leafing through a book, scribbling, or feeding a doll.

Assumptions

In this study the subjects are asked to imitate movements when one of the two stimuli is presented. The visual stimulus condition comprises a body-object motor movement demonstrated by the experimenter. The auditory-visual stimulus condition, on the other hand, comprises both the body-object motor movement and musical sound.

It is assumed that the visual qualities of the objects used in both conditions are equally appealing, if not identical. Therefore, the musical sound is believed to be

the only unique feature which makes the auditory-visual stimulus condition different from the visual stimulus condition. Moreover, the materials used in the visual test were carefully prepared so that sound level was kept to a minimum during the task demonstration. It is assumed that occasional noises from slowly leafing through a book or gently hitting a piece of thick foam are insufficient to influence responses of the subjects in the nonmusical sound condition.

Any response of a subject that was more than 30 seconds after the initial demonstration of the experimenter was given a score of 0. It is assumed that 30 seconds is a reasonable time limit for the type of response evaluated in this experiment and those responses occurring after 30 seconds were considered as not related to the initial stimulus.

Limitations

This study was designed to measure and evaluate the effects of auditory-visual and visual stimuli on imitative sensorimotor responses involving hand movements and blowing. Other imitative responses such as leg movements or speech were not tested. This study was also intended to report whether one independent variable facilitates imitative responses more than another. However, it is not within the scope of this study to determine the actual neuro-physiological processes that occurred to create the results.

The term "auditory stimuli" can be used to represent

different types of sound, including spoken voice, musical sound , or even white noise. In the auditory-visual testing condition of this study only isolated musical pitches and a short familiar tune were used.

The sample represents autistic children between the ages of 6 and 16 who were enrolled in the Center for Autism at the Genesee Intermediate School District in Flint, Michigan, at the time of the study. The subjects were drawn based on their chronological ages only. No attempt was made to match the MA or IQ levels of the subjects. The limited number of subjects (25) may influence the generalization of the experimental results.

CHAPTER II

REVIEW OF LITERATURE

This chapter attempts to review literature in four areas that are pertinent to the present study.

Part I : Autism.

Part II : Sensory/receptor preference in autistic children.

Part III : Stimulus Overselectivity in autistic children.

Part IV : Imitative behavior in autistic children.

Part V : Summary

Part I : Autism

Since Kanner's initial labeling of autism in 1943, there have been many different viewpoints concerning possible causes and necessary diagnostic criteria for this syndrome. Although definite causes remain unidentifiable at this point, the various diagnostic concepts and research have contributed to better understanding of this puzzling syndrome.

It is not within the scope of this study to describe the development of diagnostic concepts; however, it is necessary to present diagnostic criteria for the syndrome that are commonly agreed upon by clinicians and researchers at present. The description in DSM III (Diagnostic and

Statistical Manual for Mental Disorders, 1980) has been chosen for this purpose.

According to DSM III, there are six essential diagnostic criteria for infantile autism.

1. Onset before 30 months of age.
2. Pervasive lack of responsiveness to other people (autism).
3. Gross deficits in language development.
4. If speech is present, peculiar speech patterns such as immediate and delayed echollalia, metaphorical language, pronomial reversal.
5. Bizarre responses to various aspects of the environment, e.g., resistance to change, peculiar interest in or attachments to animate or inanimate objects.
6. Absence of delusions, hallucinations, loosening of associations, and incoherence as in schizophrenia. (pp.89-90)

The syndrome is further described in the Manual as having associated features including disturbances of thinking, mood and behavior.

Mood may be labile; crying may be unexplained or inconsolable; there may be giggling or laughing without identifiable cause. There is often underresponsiveness or overresponsiveness to sensory stimuli, such as light, pain, or sound. Real dangers, such as moving vehicles and heights, may not be appreciated. Peculiar nervous habits, such as hair pulling or biting parts of the body, are sometimes present. Rocking or rhythmic body movements also occur. (p.88)

Part II : Sensory/Receptor Preference in autistic children

Autistic children have been described as being impaired cognitively, involving a difficulty in relating their sensory experiences to their memories. This adaptational problem is interpreted commonly by some researchers as related to the abnormality in the receptor process of autistic children.

Golgarb (1956), and later Schopler (1965), have postulated that there are two kinds of receptors, and it is through them that human beings obtain meaningful sensory information about their surroundings. The two kinds of receptors are distance receptors, including seeing and hearing; and near receptors, including touching, tasting and smelling. The two researchers further hypothesized that a hierarchy of receptor preference in autistic children exists. The term "receptor preference" is used to describe a behavioral pattern rather than primary neurophysiological processes. This hierarchy refers to the fact that autistic children are inclined to explore their surroundings more through their near receptors than through their distance receptors. In other words, they prefer touching, smelling and tasting to seeing and hearing. This tendency of cutting off visual and auditory channels is not related to any detectable defect in their sensory apparatus for vision and audition.

Schoplar (1966) confirmed this hypothesis by testing autistic, retarded, and normal children in their preferences to visual and tactile stimuli. Thirty autistic children were compared to a group of 90 normal children and a group of retarded children whose average mental age was similar to that of the autistic children. Four standardized tests were developed to allow a comparison between tactile and visual explorations in terms of time engaged in each modality. It was found that normal children show a tendency for increased visual preference with the increase of age, while the

autistic children expressed less visual preference than both the normal and the retarded children.

Kootz, Marinelli, and Cohen (1981) attempted to assess the hierarchy hypothesis by testing sensory receptor sensitivity in autistic children in terms of their response time to three sensory modalities, namely, visual, auditory and tactile modalities. It was found that autistic and normal children have the same pattern, responding fastest to the auditory stimulus and slowest to the tactile stimulation. Kootz, et al. also made reference to the Schopler study (1966), stating that, "Schopler's finding of proximal preference in autistic children may result from differences in the methods for assessing proximal and distal stimulation." (p.273)

However, it should be noted that unless a relationship between the response time and the time engaged in a stimulus is evident, the Schopler findings cannot be interpreted as contradictory to that of Kootz, et al.. The former study was aimed to study the preference of a sensory modality in terms of time engaged in that stimulus, while the latter was attempted to study the sensitivity to a certain stimulus in terms of response time to that stimulus. It is certainly possible that autistic children may respond faster to one stimulus and yet tend to spend more time with another. Which of the two stimuli, then, do autistic children prefer? Moreover, the stimuli used in the Kootz, et al. study should be considered. For the auditory stimulus, a 1,000 Hz tone at

a 74-db sound pressure level was used. For the visual stimulus, light produced by a bare, 25-W bulb was used. A small electromagnetic vibrator attached to the child's hand was used as the tactile stimulus. The results might have been different if music was used instead of the 1,000 Hz tone, pictures or slides were substituted for the light from the bare bulb, and another tactile stimulus was used instead of the vibrator.

It is possible, then, that within each sensory modality there exists different types of stimuli which may evoke different responses in autistic children. Blackstock (1978), in his two experiments, attempted to test the effect of different stimuli within the same modality--audition. In the first experiment, 10 autistic children were compared to 10 normal children of similar age. Either of the two stimuli, musical or verbal, was presented upon depression of a single lever by the subject. It was found that the autistic subjects responded more frequently to the musical stimulus.

In the second experiment, both the musical and verbal stimuli were presented in various forms. For the musical stimulus, the first presentation consisted of a melodic passage, the second a rhythmic passage that featured various percussion instruments, and the third a harmonic passage with several instruments. For the verbal stimulus, one presentation contained poetry, the second contained the reading of a popular children's story, and the third consisted of a Russian history lesson read in Russian. The

subjects used in this experiment were 11 autistic children with a mean age of 10.3 years, 7 normal children with a mean age of 5.4 years, and 18 adults with a mean age of 19.1 years. One question that remains unclear about this experiment is why adults with a mean age of 19.1 years were compared to autistic children of 10.3 years and normal children of 5.4 years. Differences in age and ability level might have affected their choices of the stimuli.

Two wooden boxes were designed for this experiment. To each of the four sides of each box was attached a small speaker, and all speakers but one on each box were connected to tape recorders. The volume of each tape recorder was adjusted so that it was necessary to put an ear to the speaker to hear the auditory stimulus. The three tapes in one box contained the musical stimuli while the three tapes in the other box contained the verbal materials. The experimenter first demonstrated listening at each speaker, randomly alternating ears, and then directed the subject to listen. The experimenter then sat down at a desk with buttons connected to the tape recorders and recorded the subject's behavior at the speakers.

It was found that the autistic subjects in this study oriented predominantly towards musical information and listened with their left ears for the most of the time. The normal subjects demonstrated a greater variation in the preference of the two stimuli, but tended to listen to music with their left ears and verbal material with their right

ears. Blackstock explained this tendency in terms of cerebral dominance, which indicated that autistic children are predominantly right-hemisphere processors.

Kolko, Anderson, and Campbell (1980) tested the sensory preference of five autistic and five normal children by allowing them to select a visual (slides) or an auditory (music) stimulus. Two levers were presented to the subjects and their preferences were measured in terms of the total time they activated each lever. It was found that four of the five autistic children registered a preference for auditory stimulation. Another experiment was performed to test whether there would be an overselective tendency in the autistic children when a compound auditory-visual stimulation (white noise and light) was presented. It was found that the autistic children tended to attend to only one aspect of the compound stimulus, and in all cases it happened to be the sensory modality selected during the preference test.

The Kolko, et al. study provides valuable information on the sensory preference behavior of autistic children. However, the small number of subjects used in the experiment presents a problem in generalization. The results would have been more convincing if a larger number of subjects was used.

In a study by O'Connor and Hermelin (1965), the preference of visual (light) and auditory stimuli (sound and verbal material) was tested in the form of simultaneous presentation of any two stimuli in various intensity combinations. Fourteen autistic children were used in this

experiment. Results show that autistic children respond more often to intense than less intense stimuli, regardless of modality. When the intensity levels were equal, the subjects tended to respond more frequently to the auditory stimuli than to the visual stimuli. There was no difference in preference for sound or verbal material.

The O'Connor and Hermelin study adds to the literature of this area by considering the effect of intensity in the presentation of stimuli. This is an important consideration, just as the Blackstock (1978) study reveals that even within one modality there may very well be different stimulus effects on the receptor preference behavior of autistic children.

Wing (1976) also commented on the oversimplification of the sensory preference theory. She pointed out that within one sensory modality there exist stimuli with different underlying structures, such as verbal materials and musical sound. She furthered commented that the problem lies in the coding of the incoming materials by autistic children rather than the modality of the stimuli.

How, for instance, could the relative lack of responsiveness to speech and the often reported strong responsiveness to music be reconciled with a general auditory imperfection? . . . The central problem in autistic children appears to involve not [sic] stimuli in a particular modality, but stimuli requiring organisation [sic] into particular codes which are modality independent. (p.163)

Part III: Stimulus Overselectivity in Autistic Children

Although research in the area of sensory preference in autistic children is controversial, it is not without basis to say that autistic children do respond to certain stimuli in stronger ways than to other stimuli. Related to sensory preference is the notion of stimulus overselectivity, which refers to the fact that when autistic children are presented with multiple stimulus inputs, their responses are controlled by one or a few components of the stimulus complex. In a study by Lovaas, Schreibman, Koegel, and Rehm (1971), three groups of children (autistic, retarded, and normal) were reinforced for responding (bar pressing) to a complex stimulus involving the simultaneous presentation of visual, auditory and tactile cues. The stimulus presentation consisted of: a) a 160-W red floodlight, b) white noise at a moderately high intensity of 65-dB, and c) a tactile stimulus on the child's leg delivered by a pressure cuff at 20mm of mercury. After training had established the presentation as functional for the subjects' responses, single-cue test trials were presented in which each component was presented separately for a total of 70 presentations over 10 testing sessions.

It was found that the normal children responded uniformly to each of the components, which means that each of the separate cues was equally functional in controlling the subject's behavior. The autistic children, however, responded primarily to only one of the three components. Of

the five autistic subjects, three responded to the auditory cue while the other two responded to the visual cue. None of the autistic subjects responded to the tactile stimulus.

In a follow up study by Lovaas and Schreibman (1971), same experimental paradigm was used as in the previous study, except that the presentation during the training period consisted only of a visual component (red floodlight) and an auditory component (white noise). When the subjects (autistic and normal) were later presented with individual cues, it was found that seven out of the nine autistic subjects responded to only one component. The normal children gave no sign of stimulus overselectivity.

In both of the above studies, the cue which remained nonfunctional when presented with other cues could be established as functional when trained separately. This suggests that the unresponsiveness to certain stimuli is not a function of an impairment in any one sensory modality.

Koegel and Wilhelm (1973) attempted to determine whether previous findings on overselectivity would still be evident if all the stimuli used were in the same sensory modality. Fifteen autistic and fifteen normal subjects were trained to respond to a card containing two pictures. After the training discrimination was established, single cues were presented to assess the amount of control exercised by each of the two components. It was found that 12 of the 15 autistic children responded to only one picture. On the other hand, 12 of the 15 normal children showed clear

evidence of control by both cues of the training card.

In a study by Wilhelm and Lovaas (1976), a relationship between IQ level and stimulus overselectivity was observed. Three groups of children with different IQ levels participated in this study. The first group consisted of 10 severely reatrdded children with a mean IQ of 39.3. The second group consisted of 10 moderately retarded children with a mean IQ of 66.1. In the third group, there were 10 nonretarded children. The subjects were trained to discriminate between stimulus cards containing two or more pictures. At the completion of the training phase, the subjects were presented with pictures singly in order to determine how many pictures the subjects would respond to. It was found that the severely retarded children responded to an average of 1.6 cues, the moderately children responded to an average of 2.1 cues, and the nonretarded children responded to all three cues. The researchers suggested that IQ levels may be related to overselective behavior. The lower a person's IQ level, the less of the environment becomes functional in controlling his behavior. The relationship between chronological age and stimulus overselectivity has also been reported in a study by Schover and Newsom (1976), where the younger the children (autistic and normal), the more likely they were to show overselectivity.

Since the first report of stimulus overselectivity (Lovaas, et al., 1971), similar findings regarding stimuli

from different sensory modalities have been reported in several other studies (Reynolds, Newsom, and Lovaas, 1974; Koegel and Schreibman, 1977; Litrownik, McInnis, Wetzell-Pritchard, Filipelli, 1978). While researchers indicated that this overselective behavior tends to interfere with autistic children's learning and with the generalization of that learning to new environment (Varni, Lovaas, Koegel and Everett, 1979; Rincover and Koegel, 1977; Cook, Anderson and Rincover, 1982), remedies have also been sought (Schreibman, 1975; Schreibman, Koegel, and Craig, 1977; Koegel and Schreibman, 1977).

While the reduction of overselectivity remains a difficult task, it may be beneficial to make use of this characteristic in a more positive way. For if certain stimuli are found to be more functional than others, those which facilitate better responses can be recommended as better means of establishing contact with autistic children. It is the purpose of this study to examine, based on results of previous research, whether the two stimuli, auditory (music) and visual, would have different effects on imitation, a skill which can serve as an avenue to better adaptation in autistic children.

Part IV : Imitative behavior in autistic children

In a study by Lovaas, Freitas, Nelson, and Whalen (1967), imitation was demonstrated to be a foundation for more substantial and enduring behavioral changes. Eleven autistic

children participated in this program consisted of two phases. The first phase consists of the establishment of generalized nonverbal imitative behavior, while the second deals with the use of these newly established imitative skills to build and expand some socially and intellectually useful behaviors. Upon the completion of the entire program, it was found that by the use of imitation, the trainers were able to teach the children a number of behavior patterns which would have been virtually impossible to train otherwise. The more complex the target behavior is, the more useful imitation training procedure has been.

One aspect which makes this study particularly relevant to the present study is the use of imitative tasks which involve auditory and visual cues to attract the attention of the subjects. The facilitative effects of auditory and visual cues on the training of imitative behavior is suggested.

Although imitative behavior was demonstrated in the Lovaas, et al. study as being useful for learning adaptational skills, the initial establishment of such imitative capacities in autistic children remains a difficult task. Curio (1978) tested the sensorimotor abilities of twelve mute autistic children in 1) object permanence, 2) gestural imitation, 3) means for obtaining desired environmental events, and 4) causality. It was found that subjects performed most poorly on imitative tasks, with 9 of 12 performing below Piaget's fifth sensorimotor stage. Jones

and Prior (1985) also commented on the poor body imitation ability in autistic children, and suggested that poor body imitation skills may preclude adequate learning of communicative gestures. Ritvo and Provencher (1953) refer to the poor imitative ability as a reflection of

the tenuous nature of the object relationship in these children. The self and the nonself would seem to be insufficiently differentiated... The process of imitation presupposes both a certain distance from and a certain closeness to the object. In imitation the transformation of the self is carried out according to an image of the object or the nonself. Thus it appears to be a part process of identification. (p. 159)

While Ritvo and Provencher commented on the poor imitative capacities of autistic children, Hammes and Langdell (1981) further demonstrated the abilities of autistic children at different levels of imitation. Eight autistic and eight retarded children were tested on four levels in the development of motoric imitative abilities. While the first level involves an imitation of ongoing behaviors, the second level requires the subjects to reproduce the behavior long after the model is absent. The third level consists of using body parts as objects to imitate, and the fourth level is imitation with a symbolic quality. It was found that autistic children could imitate at the most basic, concrete manner. They also tended to use objects in a real rather than a pretend manner. The absence of symbolic gestures prohibited them from performing levels three and four successfully. On the other hand, retarded children were proved to be more successful in all levels in this

experiment.

DeMyer, et al. (1972) compared the abilities of 12 autistic or early schizophrenic children and 5 nonpsychotic retarded children in body imitation, motor-object imitation and spontaneous object use. In body imitation, the subjects were asked to imitate the experimenter's body movements. In motor-object imitation, the subjects were asked to imitate the experimenter's movements made with an object; and finally in spontaneous object use, the subjects were given an object to manipulate. How the subjects used the object was observed and classified according to the approximate mental age related to such a behavior. It was found that autistic children did poorly in body imitation, better in motor-object imitation, and best in spontaneous object use. DeMyer, et al. explained the results in terms of visual memory and knowledge of body parts. Body imitation was proved to be the most difficult in the experiment because the subjects must remember a visual stimulus which leaves little or no trace on its environment, and then transfer this information to the motor system and perform the movement using his body parts. Although in motor-object imitation no trace is left after the motion is demonstrated, subjects have a concrete reference point, the object as a reference. Spontaneous object use requires even less visual memory or knowledge of body parts. For example, zipping a stationery zipper is one of the spontaneous use tasks which requires little visual memory.

Another study done in this area is by Hingtgen, Coulter

and Churchill (1967), involving an intensive training program participated in by two autistic children. Reinforcements like food, water, and release from physical restraint were used in establishment of imitation in body and object use in these children. After the 21 day intensive training, over 200 imitative responses were established. A five-month follow up study shows that the skills learned were useful in establishing other complex adaptational skills in the two children. This study yields a similar result to the one done by Lovaas, et al., except that the small number of subjects in this study limits the generalization of the results.

Part V : Summary

In summary, the findings demonstrate that autistic children have a tendency to prefer certain stimuli over others. Although earlier researchers (Goldfarb, 1956; Schopler, 1965) believed that near receptors are preferred more than distance receptors by autistic children, the oversimplification of this theory has been pointed out by recent researchers. Since within one modality there exist stimuli of various qualities, it is rather inconclusive to say that autistic children prefer one sensory modality over another under all circumstances. Autistic children have also been described as overselective in their responses to multiple stimuli presented simultaneously.

This study attempts to determine which of the two stimuli, auditory (music)-visual or visual, is more

facilitative under one specific training situation-- establishment of imitative behavior--which has been suggested to be a foundation for more complex behaviors.

In establishing motor imitative behavior, the initial demonstration by the experimenter is presented as a visual cue or stimulus. Would the addition of musical tones to this visual cue facilitate the responses of autistic children? Applebaum, Egel, Koegel, and Imhoff (1979) stated that autistic children tend to perform as well as or even better than a group of age-matched normal children in imitating individual tones and series of tones delivered by voice, piano and synthesizer. Could it be possible that autistic children have a special interest in musical stimuli? Some educators have identified music as a special skill that autistic children have (Tinbergen and Tinbergen, 1983; Wing, 1985). Other studies have also demonstrated that music is very effective when used as a reinforcement to establish imitative behavior in severely retarded children. (Underhill and Harris, 1974; Dorow, 1975).

Since imitative ability has been suggested as a foundation in building more complex behavior, it would seem important to investigate whether one type of stimulus is more effective than another in facilitating imitative responses.

CHAPTER III

DESIGN OF THE STUDY

Sample

The sample in this study consisted of 25 autistic children. All subjects were enrolled in the Center for Autism at the Genesee Intermediate School District in Flint, Michigan at the time of this study. They ranged in age from six to sixteen years old, and represented six classrooms from the pre-school, elementary and intermediate sections of the program. Of the 25 subjects, 17 were male and 8 were female.

The subjects were divided into two groups. One group was administered the auditory-visual test condition while the other group was administered the visual test condition. The subjects were divided prior to the study, and teachers of all subjects had been consulted to provide greatest degree of assurance in the equality of motor ability, attention span and mean chronological ages in the two groups. Of the 13 subjects in the auditory-visual group, 9 were male and 4 were female. Of the 12 subjects in the visual group, 8 were male and 4 were female. The mean chronological ages of subjects in the auditory-visual and visual groups were 10.38 years and 10.08 years respectively.

Of the 25 subjects, none had received any previous formal

training in music, such as individual music lessons on a single instrument or voice. However, 7 out of the 25 subjects had participated in music therapy sessions prior to this study, conducted by the experimenter once a week for a period of six months. There are two reasons why these subjects were not excluded from the sample. First, exclusion of these subjects would have reduced the already small sample to an even smaller size of 18. Second, these subjects were selected to participate in the music therapy treatment because they had been reported by their teachers as being "responsive to music". Although there is no evidence to support this observation, exclusion of these subjects may have increased the chance of having a group of subjects relatively "less responsive" to music. As a result, all autistic children at the Center for Autism between the ages of six and sixteen years old were included in the sample.

Efforts were made to balance the two groups in every aspects, and therefore these seven subjects were assigned to the groups according to their degrees of responsiveness to music (based on observation of the experimenter) besides age, motor ability and attention span. Results of these 7 subjects were compared to the results of the other 18 subjects for any possible differences in imitative abilities.

Setting and Experimental Procedure

Each subject was tested one time, during a ten-minute music session. The experimenter conducted all the testing

sessions on a one-to-one basis with each subject. The subjects were tested on either the visual or the auditory-visual test.

The experiment took place in a large, well-lighted room that included a table, a video camera on a tripod, and two chairs. The chairs were positioned side by side so that the experimenter and the subject could sit next to each other during the testing session. The camera operator stood behind the camera in one corner of the room where movements of both the experimenter and the subject could be seen.

Each subject was escorted from the classroom by the experimenter to the testing room. The testing session followed this three-step format:

1. Two warm-up music activities consisting of a hello song and a body percussion activity to help acquaint the subject with the experimenter.
2. A test of five items to measure accuracy in the imitation of tempo and number of motions.
3. A wrap-up activity which allowed the subject to play an instrument or sing a goodbye song.

(For an example of the narration to be used in instructing each subject please see Appendix A).

Experimental Tasks

Autistic children have usually been described as "untestable," due to the fact that very often during testing sessions they display a combination of characteristics, including short attention span, lack of interpersonal motivation and bizarre response patterns, which apparently

interfere with test taking skills. Some researchers have concluded that standard intelligence tests are inapplicable for testing autistic children (Gallagher, 1962; Spivack and Levine, 1964). Alpern (1967) suggested that because of the low social and cognitive levels and extreme attentional disorders of autistic children, use of a modified infant test would be appropriate for this type of subjects.

In the search for a possible pool of tasks for this study, various test literature (Alpern, 1967; Alpern and Kimberlin, 1970; Bayley, 1969; Cattell, 1940; Doll, 1953; Flaharty, 1976; DeMyer, et al., 1972) have been consulted. Because the tasks had to be demonstrated using musical stimuli, standardized test items were not applicable. However, in designing the present tasks, the experimenter has tried to equate the level of difficulty of these tasks as much as possible to the level of tasks proved appropriate for autistic children. Inasmuch as the tasks were to be used with autistic children of a somewhat wide age range (six to sixteen years old), efforts were made to assure that all subjects could perform the tasks successfully. The sensorimotor tasks used in this study were estimated to be at a 24-60 month MA level. However, exact imitation of the tempo and number of motions of the tasks would require skills at a higher level.

Presentation of tasks

During each testing session the subject was asked to imitate five sensorimotor tasks after initial demonstration by the experimenter. The task demonstration was as follows:

Auditory-visual test items

1. Experimenter demonstrated hitting a xylophone with a mallet 5 times, at the tempo of 50 beats/minute.
2. Experimenter demonstrated leafing through a "book" made up of 5 musical greeting cards, at the tempo of 50 beats/minute.
3. Experimenter demonstrated shaking a bell 5 times at tempo of 50 beats/minute.
4. Experimenter demonstrated strumming an autoharp with a pick, away from the body 5 times, at the tempo of 50 beats/minute.

Visual test items

1. Experimenter demonstrated hitting a xylophone (on which the bars had been replaced by thick foam bars) with a mallet 5 times, at the tempo of 50 beats/minute.
2. Experimenter demonstrated leafing through a "book" made up of 5 greeting cards, at the tempo of 50 beats/minute.
3. Experimenter demonstrated shaking a bell with the clapper removed, 5 times at the tempo of 50 beats/minute.
4. Experimenter demonstrated strumming an autoharp (the strings on which were covered with a piece of felt) with a pick, away

from the body 5 times, at
the tempo of 50 beats/
minute.

- | | |
|--|--|
| <p>5. Experimenter demonstrated
blowing into a slide
whistle 5 times, at the
tempo of 50 beats/minute.</p> | <p>5. Experimenter demonstrated
blowing into a slide
whistle (with reed covered)
5 times, at the tempo of
50 beats/minute.</p> |
|--|--|

Each test item required the subject to perform a motor-object imitation. The first task (playing xylophone) required imitation of an up-and-down motor movement using the dominant hand of the subject. The second task (leafing through a book) required imitation of motor movements of the fingers. The third task (shaking a bell) was aimed to demonstrate imitation of a motor movement of the wrist. The fourth task (strumming autoharp) required imitation of a horizontal motor movement of the arm. Finally the fifth task required imitation of blowing an object.

Scoring

After the initial demonstration of each task, any response that occurred within 30 seconds was considered related to the initial stimulus. This response time was counted from the moment the experimenter handed the test object to the subject upon completion of the demonstration to the time the subject started his/her first motion of imitation. Any response that occurred 30 seconds after the

test object was grasped by the subject was not considered a related response, and the score for that particular item was 0. Any subjects who refused to accompany the experimenter to the testing room, or scored 0 in all the tasks were eliminated from the study, and the information was disregarded in the computation of results.

The five test items that each subject performed were videotaped using a Betamax I video camera. Actual measurement and assigning of scores did not take place until after all the subjects were tested. Both of the two raters were graduate students at the University of Michigan, and they were trained briefly by the experimenter as to the criteria for score assignment. Viewing of the videotape by two raters took place independently, and there was no discussion between the raters about the scores. Unlike measurements in physical sciences, measurements in behavioral sciences can often be subjective and controversial. In this case, for example, determining an exact tempo for a motor response could be very difficult. As a result two persons might very well come up with different decisions for the same response. For this reason the Pearson product-moment formula was used as a reliability test for determining correlation of judgement between the two raters.

After first viewing of the videotape the correlation coefficients between raters were found to be 0.99 for the tempo scores and 0.96 for the motions scores. These coefficients were determined to be sufficient in

demonstrating high reliability in judgement making process between the two raters. After the first viewing, raters were asked to re-evaluate items that did not yield agreement between the two raters. For the items which did not yield agreement after the second viewing, an average was accepted as the final score for each of these items.

The accuracy of the subjects' responses was evaluated in terms of tempo and number of motions. Hence in each task two scores were assigned, one for tempo and one for number of motions. The rating scale was from 0 to 5, with 5 being the highest score. Since there were 5 tasks involved in the experiment, maximum attainable scores was 25 for the tempo part and 25 for the motions part.

For all the five tasks, the required tempo was a standardized 50 beats/minute. When a subject imitated the motion in the vicinity of 50 beats/minute, he/she would get a perfect score of 5. The score was judged lower as the tempo deviated more from that of the initial demonstration.

By the same principle, the standardized required number of motions was 5 for all the tasks. When the subject responded by performing the movement 5 times, he/she would get a score of 5. If he/she executed the task 4 or 6 times, he/she would get a score of 4, and so on. (For a detail breakdown of the rating scale, please refer to Appendix B.)

After all the scores had been assigned, computation was made to determine whether significant differences existed between mean scores of the two groups in terms of tempo and

number of motions. Results of those subjects who had previous music-related contact with the experimenter were also compared to the results of those who had not.

Materials

The materials used in this study included a table and two chairs, a Betamax I video camera, a Betamax I video cassette recorder, a BASF 750 video tape, two stop watches, scoring sheets, two metronomes, two xylophones, two mallets, five musical greeting cards, five ordinary greeting cards, two autoharps, two autoharp picks, one ordinary bell, one bell with the clapper removed, and two slide whistles, one with the reed covered.

The bars on one of the xylophones were replaced by foam bars to eliminate sound when hit. The foam bars were cut to the exact sizes as the real wooden bars, and were painted with the same color as the wooden bars, so that appearances of the two instruments would be very similar. For one of the autoharps, a piece of felt was used to weave in and out through the strings in order to eliminate sound when strummed. The color of the felt was very similar to that of the wooden part of the other autoharp so that the two instruments would look alike. The designs on the five musical greeting cards were identical to that of the five ordinary greeting cards. The two bells used were identical except that the clapper on one of them was removed. The two slide whistles used also were identical except that the reed

on one of them was covered with a tiny piece of foam. Efforts were made to assure that instruments used in the two testing conditions were very similar.

Statistical Treatment

The data collected were analysed using t tests of two small uncorrelated samples. A t test was used to determine whether a statistically significant difference existed in the accuracy of imitative responses between the two groups of subjects in terms of tempo. Another t test was used to determine whether a statistically significant difference existed in the accuracy of imitative responses between the two groups of subjects in terms of number of motions.

The Mann-Whitney U test was used to determine if a statistically significant difference existed between results of those subjects who had previous contact with the experimenter through participation in music therapy sessions and those who had not.

CHAPTER IV

RESULTS

Findings

This study examined the effects of auditory-visual and visual stimuli on imitative sensorimotor responses in autistic children. Twenty-five autistic subjects were assigned to two experimental conditions, each characterized by having subjects imitate five sensorimotor tasks.

Two scores were recorded for each task. The first score reflects how accurate the imitative response was in terms of tempo, while the second score reflects how accurate the response was in terms of number of motions. Thus, each subject had two sets of scores: the first set consists of five "tempo" scores and the second set consists of five "motions" scores. Raw data and demographic information of all subjects are included in Appendix C.

For the purpose of computation, the five "tempo" scores have been grouped into one "total tempo" score. The "motions" scores have also been grouped in the same way. Hence each subject had only two scores, one in tempo and one in motions. Statistical analyses were done using these "total" scores. The maximum attainable total score was 25 in either area.

None of the subjects received a total score of 0, and therefore scores of all subjects were included in the computation of results.

Table 1 shows the total tempo scores of subjects in both the auditory-visual and the visual groups. Scores in the auditory-visual group range from 3 to 25, with a mean of 12.65 and a standard deviation of 7.77. Among the 13 subjects, two obtained perfect scores of 25.

Scores in the visual group range from 1 to 23, with a slightly lower mean of 11.42 and a standard deviation of 7.15.

Table 2 shows the total motions scores of subjects in both the auditory-visual and the visual groups. Scores in the auditory-visual group range from 4 to 24, with a mean of 12.04 and a standard deviation of 5.94. Scores in the visual group range from 1 to 12.5, with a mean of 7.58 and a standard deviation of 3.96. Notice that standard deviations of the motions scores are apparently lower than that of the tempo scores, indicating a less varied distribution of scores.

Review of Research Questions

1. Is there a statistically significant difference in the accuracy of tempo between the auditory-visual and the visual groups?

TABLE 1
TOTAL TEMPO, MEAN AND STANDARD DEVIATION
SCORES FOR THE AUDITORY-VISUAL AND VISUAL GROUPS

Auditory-Visual group		Visual group	
Subject	Score	Subject	Score
1	23	9	13
2	9	10	5
3	3	11	10
4	9	12	16
5	17	13	15
6	15	14	18
7	7.5	15	15
8	25	16	4
18	12	17	23
19	5	20	1
22	10	21	1
23	4	25	16
24	25		
n = 13		n = 12	
$\bar{X} = 12.65$		$\bar{X} = 11.42$	
SD = 7.77		SD = 7.15	

TABLE 2
TOTAL MOTIONS, MEAN AND STANDARD DEVIATION SCORES
FOR THE AUDITORY-VISUAL AND VISUAL GROUPS

Auditory-Visual group		Visual group	
Subject	Score	Subject	Score
1	18	9	6.5
2	11	10	9.5
3	6	11	9
4	5	12	5
5	11	13	9
6	12	14	12.5
7	13.5	15	12
8	16	16	6
18	16	17	12.5
19	5	20	1
22	15	21	1
23	4	25	7
24	24		
n = 13		n = 12	
$\bar{X} = 12.04$		$\bar{X} = 7.58$	
SD = 5.94		SD = 3.96	

The mean tempo scores, in the scale of 0 to 25, were found to be 12.65 and 11.42 for the auditory-visual and the visual groups, respectively.

A t test was used to determine if a statistically significant difference existed between these two mean scores. A t value of 0.4132 at $df = 23$ was found not to exceed the table value of 2.069 required for significance at .05 level of confidence.

2. Is there a statistically significant difference in the accuracy of number of motions between the auditory-visual and the visual groups?

The mean motion scores, in the scale of 0 to 25, were found to be 12.04 and 7.58 for the auditory-visual and the visual groups, respectively.

Again, a t test was used to determine if a statistically significant difference existed between these mean scores. A t test value of 2.186 at $df = 23$ was found. This value exceeds the table value of 2.069 at .05 level of confidence.

3. Do the scores of the individuals who had contact with the experimenter through participation in music therapy sessions differ from those who had not?

Seven of the 25 subjects had contact with the experimenter through participation in her music therapy sessions for six months prior to this study. These seven subjects will henceforth be referred to as "old" subjects, as opposed to the other 18 "new" subjects who neither had contact with the experimenter nor experience in a music

therapy group prior to this study. Four of the old subjects were assigned to the auditory-visual group, while the other three were assigned to the visual group. The assignment of these seven subjects was made the same way as the assignment of the other 18 subjects, except that their degrees of responsiveness to music were also considered besides age, motor ability and attention span. Efforts were made to determine if previous contact with the experimenter and exposure to musical stimuli through participation in a music group would affect performance in imitative tasks by these subjects.

Due to a small sample size and an uneven number of subjects, a nonparametric test (The Mann-Whitney U-test) was used to determine if a statistically significant difference existed in the rank order values of the two types of subjects.

Tables 3 and 4 illustrate the U-test analyses of differences between the two types of subjects in the two experimental conditions for both tempo and motions scores.

As shown in Table 3, U-values for tempo and motions scores between the two types of subjects in the auditory-visual group were 10 and 14.5 respectively. These values did not correspond with the needed table value for a two-tailed test with $n_1 = 4$ and $n_2 = 9$ at .05 level of confidence.

TABLE 3
 U-TEST ANALYSIS OF DIFFERENCES BETWEEN
 THE TWO TYPES OF SUBJECTS IN THE
 AUDITORY-VISUAL GROUP

Score Category	"old"subjects No. of cases	"new" subjects No. of cases	U
Tempo	4	9	10
Motions	4	9	14.5

TABLE 4

U-TEST ANALYSIS OF DIFFERENCES BETWEEN
THE TWO TYPES OF SUBJECTS
IN THE VISUAL GROUP

Score Category	"old" subjects No. of case	"new" subjects No. of cases	U
Tempo	3	9	8
Motions	3	9	8

U-values for tempo and motions scores between the two types of subjects in the visual group were shown to be 8 in both cases (Table 4). These values did not correspond with the needed table value for a two-tailed test with $n_1 = 3$ and $n_2 = 9$ at .05 level of confidence.

Summary

The results of this study revealed a statistically significant difference in the mean "motions" scores between the two experimental conditions (auditory-visual and visual). This suggests that in this study the combination of auditory and visual stimuli was more effective than visual stimuli alone in facilitating more accurate imitative responses in the number of motions.

However, results in this study did not demonstrate that the combination of auditory and visual stimuli was more effective than visual stimuli in facilitating more accurate imitative responses in tempo, or vice versa.

No relationship was observed between previous contact with the experimenter and exposure to musical stimuli, and performance in imitative tasks in the autistic children.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The syndrome of autism has long been a myth to clinicians, educators and parents of autistic children. Since Kanner's initial identification of the syndrome, many efforts have been made by researchers to search for causes of autism as well as training strategies that would best benefit autistic individuals. One of the atypical behaviors of autistic children that has puzzled researchers is their strong responsiveness to certain stimuli and relatively weak responsiveness to others.

In the search for possible causes that lead to this type of overselective behavior, researchers in the 1950s postulated the theory of sensory preference, which points out that autistic individuals tend to prefer near receptors (touching, tasting and smelling) more than far receptors (seeing and hearing). Although a number of earlier studies (Golgarb, 1956; Schoplar, 1966) have supported this hypothesis, recent studies have pointed out the oversimplification of this theory. Wing (1976) has commented in her studies that different stimuli within the same modality also have different underlying structures.

Therefore autistic children may very likely respond differently to different stimuli within the same modality. In Blackstock's study (1978), this point is validated through the fact that musical and verbal stimuli were demonstrated to bear different effects on responses of autistic subjects. Other related concerns include the effect of intensity in the presentation of stimuli (O'Conner and Hermelin, 1965), and the way preference is measured (Kootz, et al., 1981).

Controversial as it may seem, sensory preference theory has a definite value in that it identifies this overselective behavior in autistic children. Other researchers have found that this kind of overselective behavior is also prevalent in situations where multiple sensory stimuli are presented simultaneously. This "stimulus overselectivity" characteristic has been found to exist in the majority of the autistic children being tested in the various studies.

The aim of this study was to identify the type of stimuli, auditory-visual or visual, that would facilitate learning of imitative skills in autistic children.

Twenty-five autistic subjects participated in the present study. Thirteen subjects were assigned to the first experimental condition where subjects were asked to imitate five sensorimotor tasks after they were presented with auditory-visual stimuli. Twelve subjects were assigned to the second experimental condition where subjects were asked to imitate the same tasks after they were presented with visual stimuli alone. The subjects' responses were evaluated

in terms of their accuracy in tempo and number of motions.

To determine effects of the two testing conditions on imitative responses of the subjects in terms of tempo and number of motions, t tests for small uncorrelated sample were used. The Mann-Whitney U test was used to determine if there was a statistically significant difference between scores of those subjects who had contact with the experimenter through participation in her music therapy sessions prior to the study and those who had not.

Conclusions

Based on the results of this study and the statistical analysis of those results, the following conclusions have been drawn:

1. There was no statistically significant difference in the imitation of tempo between the auditory-visual and the visual groups.
2. There was a statistically significant difference in the imitation of the number of motions between the auditory-visual and the visual groups. The auditory-visual group scored higher.
3. There was no statistically significant difference between the subjects who had experienced music therapy sessions and those who had not in their imitation of tempo and number of motions.

Discussion

In contrast to the common belief that autistic individuals tend to manipulate objects in ways other than those modeled in performance of body-object imitation, over 90% of the subjects in this study did perform the tasks as modeled. Although the tempi and number of motions performed

by the subjects were not always exact, the subjects were generally proficient in demonstrating the skills necessary in achieving the required tasks. This involves, for example, playing on the bars of the xylophone instead of playing on the sides or putting the mallet in his/her mouth. Of the whole sample, only one subject (#20 in the visual group) tended to manipulate test objects consistently--spinning whatever objects the experimenter gave her. The fact that this six-year old subject was the youngest, suggests that she might not have fully understood the instructions, or she was simply too young to accomplish the tasks.

Subjects in general showed much interest in the instruments and an urge to explore them. A few subjects showed impatience during the experimenter's demonstration, and demonstrated impatience in waiting for their turns. Only one subject (#10 in the visual group) left her seat repeatedly. The attentiveness and eagerness in responding to the experimenter's requests were possibly due to the attractiveness of the instruments and the one-to-one attention received by the subjects. In general, subjects in the auditory-visual group showed more enthusiasm than subjects in the visual group. A few subjects in the visual group showed astonishment when they found that the instruments did not produce any sound. While one subject kept asking why this was the case, others reacted by hitting the instruments harder or having doubtful looks on their faces. Overall, behavioral problems were minimal during the

testing sessions.

Examination of the data of this study revealed that the combination of auditory and visual stimuli was more effective than visual stimuli alone in facilitating more accurate number of motions in the imitative responses of autistic children. One interpretation of this finding is that musical sounds, such as those used in the auditory-visual stimuli, acted as an additional cue in the sensory input and output processes, and further aided the registering and recalling of information. Thus, the subjects in the auditory-visual group not only saw the experimenter hit the xylophone five times but also heard the sound of a xylophone five times. The musical component of the auditory-visual stimuli facilitated the input process, reinforced the memory and consequently effected retention of the tasks. Hence the more sensory channels there are in the initial input, the more accurate the imitative responses may be.

Another interpretation is that autistic children simply prefer musical stimuli over visual stimuli in their inputs of information. This interpretation is related to the stimulus overselectivity theory, which states that only one or a few components of a stimulus complex are functional in controlling the responses of autistic subjects. In this case, then, the subjects prefer to respond to musical stimuli than to visual stimuli; and because musical stimuli were not present in the visual group, the results of subjects in the visual group were inferior to the results of subjects in the

auditory-visual group in the imitation of the number of motions.

As some studies have shown that music can be used as a reinforcement to establish imitative behavior in severely retarded children (Underhill and Harris, 1974; Dorow, 1975), the musical sound that subjects in the auditory-visual group heard in the experimenter's demonstration might have a reinforcing effect on their own imitative behavior. By the same principle, the musical sound that they heard from their own playing might also have motivated them to play on.

However, results of this study did not support the notion that the combination of auditory and visual stimuli was more effective than visual stimuli alone in facilitating more accurate tempo in imitative responses in autistic children. The mean tempo scores in the auditory-visual and the visual groups are 12.65 and 11.41 respectively. This small difference of 1.24 in a 25 point scale is too small to be considered significant, although the mean tempo score of the musical group is slightly higher. An examination of the raw data showed that in both testing conditions, the most frequently assigned tempo scores were 1's and 5's (in the scale of 0 to 5), with 1 representing an inconsistent tempo or tempi over 100 beats/minute or below 10 beats/minute, and 5 representing a tempo that is extremely close to the model tempo.

Interpretation of these data should be done with consideration of the way this study was designed. The model

tempo chosen for the experimental tasks was a moderate speed of 50 beats/minute. In considering the five experimental tasks required of the subjects (playing xylophone, autoharp, bell, slide whistle, and leafing through a book), it would seem quite awkward to try to perform any of the above tasks consistently at a speed too fast or too slow. For example, it would take considerable practice and dexterity before anyone can leaf through a book at the speed of 92 beats/minute! Therefore the tempo chosen might just be too "natural" for some subjects not to respond that way. This could account for the 5's in the tempo scores, meaning that for the subjects who tend to perform the tasks in a consistent tempo, 50 beats/minute was probably a natural, moderate speed at which to respond.

Consultation with the raters revealed that most of the 1's in the tempo scores were assigned for responses with an inconsistency in tempo, which is quite typical of the responses by autistic individuals. About 60% of the responses were either close to perfection or with an inconsistent tempo. The amount of 1's and 5's assigned were about the same in both testing conditions. It is possible that subjects who received the 5's would get similar results regardless of the types of stimuli used because it is only natural for them to respond at the speed of 50 beats/minute for the required tasks. Similarly subjects who received the 1's would also get similar results regardless of the types of stimuli used because their tempi would be inconsistent

anyway.

Therefore, the model tempo might not have been a good choice for the purpose of examining imitative responses of these experimental tasks. The small size of the sample also precludes the results of this study from being affected by the inconsistent responding behavior of some subjects. Hence, use of a different tempo or a variety of tempi and a larger sample size may very well change the results of this study.

The Mann-Whitney U test analysis showed that results of those who had previous music-related contact with the experimenter were not statistically significantly different from results of the subjects who had not. It should be noted that the distribution of subjects for this analysis was 9 and 4, and therefore required a less powerful rank-order scale such as that represented by the Mann-Whitney U analysis. The results confirmed the fact that the inclusion of those seven subjects had no confounding effect on the results of this study.

Recommendations for future research

The results of this study should be interpreted with consideration of the characteristics of the sample and the design of the study that are discussed below. The sample size was small, and this fact was particularly influential in the present study because of the diversified behavioral patterns of autistic subjects. For example, almost 30% of

the tempo scores were assigned for responses with an inconsistency in tempo. Consequently, comparison of the effects of the two stimuli on tempo accuracy was based on the remaining 70% of responses, making results of an already small sample even less representative.

Another factor contributing to the difficulty in justifying the results was the small number of experimental tasks. To study effectively the imitative responses of autistic children, more experimental tasks requiring different imitative movements must be utilized. Tasks of different levels of difficulty should be used for subjects of different ages. Thus, dividing subjects of the present age range (6 to 16 years) into two groups and assigning tasks of different levels accordingly would seemingly yield results that are more representative of the abilities of the subjects.

The instructions used in this study were designed to be simple and brief, with a minimum of verbal information. However, just how much the subjects understood the instructions remains unknown. It is possible that the concept of imitation was too abstract for some of the subjects to comprehend, and that they were merely trying to explore the instruments without the intention of repeating what the experimenter had done. Design of future studies using these kinds of subjects should take this fact into consideration.

Based on the findings of this research, it is therefore

recommended that study of the same nature be repeated, with the following changes:

1. Use a larger sample size and divide the sample into subgroups according to age, in the case of a large age range.
2. Use a larger number of experimental tasks and assign tasks of different levels of difficulty to subjects in different age groups accordingly.
3. Use a variety of tempi.
4. Instructions to autistic subjects should be carefully planned. A pilot study is necessary to evaluate understanding of the instructions by the subjects.

In addition, various types of musical stimuli can be used to compare their differences in effectiveness; for example, use of recorded music, instrumental music, or vocal music. Moreover, examination of the effects of musical stimuli on establishment of other skills in autistic children can be done. Future studies that can increase understanding of the effects different stimuli have on the learning process in autistic children would be very valuable.

APPENDICES

APPENDIX A
PROCEDURE FOR TESTING SESSION

PROCEDURE FOR TESTING SESSION

1. Preliminary activities

a) Hello song

"Hello, (Subject's name), please have a seat. Let's start off by singing a hello song."
(experimenter sings and plays hello song on guitar.)

b) Warm-up activity

"Now let's do some movements together. Follow me and do what I do."
(start tape. Do clapping, patting knees, stamping and other body percussion to recorded music.)

2. Test items

a) Playing xylophone/playing xylophone without sound

"Now we're going to play the xylophone. I'm going to play first, and I want you to repeat exactly what I do."

(hit xylophone with mallet 5 times, at a tempo of 50)

"Now you do it, exactly the same way as I did it."

(hand mallet to subject, repeat instruction once if subject does not respond in five seconds)

b) Same procedure for the other four test items, except changing names for different instruments in instructing.

3. Wrap-up activity

"Thank you very much for doing this with me. Now you may choose an instrument that you'd like to play."

(hand subject with a box of percussion instruments such as maracas, tambourines, woodblocks. Play instrument with subject. If subject does not pick an instrument, sing and play goodbye song with subject. Then escort subject back to the classroom.)

APPENDIX B
SCORING SHEET

SCORING SHEET

Tempo score (Model tempo=50)

0 _____	1 _____	2 _____	3 _____	4 _____	5
No response	10 & below, 100 & over, no consistent tempo	10-20, 88-100	20-30 72-84	30-40, 60-69	42-58

Required Number of motion (5)

0 _____	1 _____	2 _____	3 _____	4 _____	5
No Response	1, 9 & over	2, 8	3, 7	4, 6	5

APPENDIX C
RAW DATA AND DEMOGRAPHIC INFORMATION

RAW DATA AND DEMOGRAPHIC INFORMATION

Auditory-Visual Group

Subject ID no.	Sex	Age in years	Tempo scores	Motions scores
1	M	10	a) 5 b) 5 c) 3 d) 5 e) 5	a) 2 b) 3 c) 5 d) 4 e) 4
2	M	8	a) 3 b) 3 c) 1 d) 1 e) 1	a) 3 b) 1 c) 1 d) 1 e) 5
3	F	7	a) 1 b) 0 c) 1 d) 1 e) 0	a) 1 b) 0 c) 4 d) 1 e) 0
4	M	9	a) 1 b) 1 c) 2 d) 1 e) 4	a) 1 b) 1 c) 1 d) 1 e) 1

Task a) Playing xylophone
 b) Playing autoharp
 c) Leafing through greeting cards
 d) Playing bell
 e) Playing slide whistle

Subject ID no.	Sex	Age in years	Tempo scores	Motions scores
5	M	8	a) 1 b) 5 c) 1 d) 5 e) 5	a) 1 b) 2 c) 2 d) 2 e) 1
6	M	8	a) 1 b) 2 c) 5 d) 2 e) 5	a) 1 b) 1 c) 5 d) 3 e) 2
7	M	15	a) 1 b) 1 c) 3.5 d) 1 e) 1	a) 3.5 b) 1 c) 5 d) 1 e) 1
8	F	12	a) 5 b) 5 c) 5 d) 5 e) 5	a) 1 b) 4 c) 5 d) 5 e) 1
18	F	16	a) 1 b) 1 c) 3 d) 2 e) 5	a) 1 b) 5 c) 5 d) 4 e) 1

Subject ID no.	Sex	Age in years	Tempo scores	Motions scores
19	F	6	a) 1 b) 1 c) 1 d) 1 e) 1	a) 1 b) 1 c) 1 d) 1 e) 1
22	M	12	a) 1 b) 3 c) 1 d) 4 e) 1	a) 1 b) 4 c) 5 d) 2 e) 3
23	M	10	a) 1 b) 1 c) 1 d) 1 e) 0	a) 1 b) 1 c) 1 d) 1 e) 0
24	M	14	a) 5 b) 5 c) 5 d) 5 e) 5	a) 4 b) 5 c) 5 d) 5 e) 5

Visual Group

Subject ID no.	Sex	Age in years	Tempo scores	Motions scores
9	F	9	a) 1 b) 5 c) 5 d) 1 e) 1	a) 1 b) 1 c) 2 d) 1.5 e) 1
10	F	8	a) 1 b) 1 c) 1 d) 1 e) 1	a) 1 b) 1 c) 2.5 d) 1 e) 4
11	M	6	a) 1 b) 4 c) 3 d) 1 e) 1	a) 1 b) 2 c) 4 d) 1 e) 1
12	M	11	a) 5 b) 5 c) 1 d) 2 e) 3	a) 1 b) 1 c) 1 d) 1 e) 1
13	M	11	a) 4 b) 4 c) 3 d) 4 e) 0	a) 1 b) 2 c) 5 d) 1 e) 0

Subject ID no.	Sex	Age in years	Tempo scores	Motions scores
14	M	10	a) 1 b) 5 c) 5 d) 3 e) 4	a) 1 b) 1 c) 5 d) 2.5 e) 3
15	M	14	a) 1 b) 4 c) 4 d) 1 e) 5	a) 1 b) 4 c) 5 d) 1 e) 1
16	F	12	a) 2 b) 1 c) 1 d) 0 e) 0	a) 2 b) 3 c) 1 d) 0 e) 0
17	M	11	a) 5 b) 5 c) 5 d) 4 e) 4	a) 1.5 b) 3 c) 5 d) 2 e) 1
20	F	6	a) 0 b) 0 c) 1 d) 0 e) 0	a) 0 b) 0 c) 1 d) 0 e) 0

Subject ID no.	Sex	Age in years	Tempo scores	Motions scores
21	M	10	a) 1 b) 0 c) 0 d) 0 e) 0	a) 1 b) 0 c) 0 d) 0 e) 0
25	M	8	a) 1 b) 4 c) 4 d) 2 e) 5	a) 1 b) 2 c) 2 d) 1 e) 1

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