MEMORY--A COMPARISON OF ROTE REHEARSAL VERSUS THE STORY NARRATIVE MNEMONIC FOR THE RECOGNITION, IDENTIFICATION, AND RECALL OF MUSICAL INTERVALS

By

NEDRA KOEN ROYE

Bachelor of Education
University of Missouri
Columbia, Missouri
1964

Master of Education
University of Missouri
Columbia, Missouri
1968

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
DOCTOR OF EDUCATION
December, 1986

MEMORY--A COMPARISON OF ROTE REHEARSAL VERSUS THE STORY NARRATIVE MNEMONIC FOR THE RECOGNITION, IDENTIFICATION, AND RECALL OF MUSICAL INTERVALS

Thesis Approved:

Thesis Adviser

Dean of the Graduate College

ACKNOWLEDGMENTS

The author wishes to express her sincere appreciation to the members of her doctoral committee. Special appreciation is extended to Dr. Russell Dobson, the author's major adviser, for his patience, encouragement, and assistance in the preparation of this study. Appreciation is also extended to Dr. Vernon Troxel for his time and assistance given to the statistical aspect of the study, and to Dr. Judith Dobson and Dr. Bernard Belden for their assistance and suggestions.

A special note of thanks is extended to the children and teachers whose cooperation made this study possible. Above all, special love and gratitude is expressed to my husband, Jim, and children, Georgeann and Reed, for their understanding, encouragement, and many personal sacrifices for this long endeavor. Finally, very special thanks and gratitude to my mother and aunt, Mrs. Ruth Koen and Mrs. Naomi Knight, for their love, support, and encouragement.

TABLE OF CONTENTS

Chapter | Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

THE RESEARCH PROBLEM

Nature of the Problem

Memory plays a key rôle in almost all kinds of learning. Memory refers to the ability to store information that has been sensed, perceived, and learned. It also refers to the ability to retrieve that information from storage when it is needed. Because memory plays such a vital role in every aspect of learning, a disability in this function impedes many areas of learning (Lerner, 1981).

Studies have shown that most children and adults are inefficient learners. They do not make use of a variety of encoding processes past rote rehearsal, rereading, simple organizational schemes (outlining), and various cueing devices (underlining) (Bjork, 1979). Several authors have expressed that the main reason for the lack of application is that students are rarely taught how to make the most of their memory capability. Cermak (1975, p. 113) has argued that "it is time our school systems let all of our students in on these techniques for memorization. Courses on how to improve one's memory should be reintroduced into our curriculums and taught as actual academic courses." Higbee (1979) argues that memory and systems are almost never used in schools because educators resist the idea that memorization is an important part of schooling. He points out, however, that learning basic facts is the first minimum requirement of students in schools and improvement in memorization would help students learn basic facts more easily allowing them to proceed toward higher educational goals, such as critical thinking. Chalfant and Scheffelin (1969) conclude that educators should identify the specific memory problem of the child and intervene with specific techniques designed to improve learning.

Torgesen (1977) suggests that memory problems are not due to limited capacity but rather a difficulty in the management of intact memory capacities. In a study of children with reading disabilities, he found that these students manifested a general lack of reflective knowledge about memory and memory processes, as well as a generally disorganized approach to cognitive tasks. Significant differences were found between good and poor readers in their knowledge about memory strategies, such as rehearsal, ability to generate a variety of different solutions to a memory problem, and planning for real-world memory problems. He suggests that teaching can make a difference by helping children develop strategies for memorizing. Research indicates that appropriate environmental factors and teaching can help children improve in what they can remember (Wiseman, 1965; Vergason, 1968).

Biehler and Snowman (1982) suggest that mnemonic devices are essentially rule-governed systems designed to improve recall. Mnemonic means "aiding the memory." They range from simple, easy-to-learn techniques to somewhat complex systems that require a fair amount of practice. Popular in memory-training books have been rhymes, acronyms (first letter), acrostics (sentence), peg words (associations based on rhyme), stories (link method), and visual imagery. Four mnemonic systems have received considerable research interest during the 1970's: the Loci system (association with places), the Peg system, the Phonetic system (a sophisticated Peg system), and the Key Word method (the newest to be devised). The Key Word method first appeared in 1975 as a means for learning foreign language vocabulary. The technique involves two steps. First, some part of the foreign word is isolated that, when spoken, sounds like a real English word. This is the key word. Second, an interacting visual image is formed between the key word and the English translation of the foreign word. Thus, the foreign word becomes associated to the key word by an acoustic link and the key word becomes associated to the English translation by an imagery link. Higbee (1979) emphasizes the use of visual imagery as a mnemonic technique for three reasons: it is probably the most unusual aspect of mnemonic systems, it is used by most mnemonic systems, and it is the mnemonic technique that has been of most research interest during the 1970's.

Mnemonic devices work well because they enhance the encodability and retrievability of information. First, they provide a context (such as acronyms, sentences, mental walks) in which apparently unrelated items can be oriented. Second, the meaningfulness of to-be-learned material is enhanced through associations with more familiar, meaningful information (for example, memory pegs or loci). Third, they provide distinctive retrieval cues that must be encoded with the to-be-learned material. Fourth, they force the learner to be an active participant in the learning process, to think about the nature and meaning of the learning material (Morris, 1979). Teaching students how to use mnemonic devices can serve an important motivating function. Also, mnemonics can point out to the student that the ability to learn and remember large amounts of information is an acquired capability (Biehler and Snowman, 1982).

Is research on mnemonics having an effect on education? Bower (1973a) suggests a number of educational uses of mnemonics and gives examples of how different mnemonics can be used in school work. But the incorporation of mnemonics and higher level organizational techniques may be a slow process. Higbee (1979) discusses some attempts that have been made to use mnemonics for instruction. Programs for teaching reading that are based on mnemonics have been developed (Wendon, 1972; Michael, King, and Moorhead, 1978). Visual imagery has been found to help in learning sentences, vocabulary, prose material and concepts. Morrison, Giordoni, and Nagy (1977) found that reading disabilities may be due to deficiencies in memory skills rather than in perception. Gallimore, Lam, Speidel, and Tharp (1977) found that a story mnemonic can aid kindergarten children's long-term retention of geometric shapes used in pre-letter-learning preparation. Jorm (1977) found that high-imagery words are easier for poor readers to read than are low-imagery words.

A common argument against teaching and using mnemonics in education is that they help only with memorization of meaningless, unrelated facts, but not with the higher educational goals of understanding, reasoning, and creative thinking. But if memory plays a key role in the learning process and educators understand this role, then mnemonics can be seen as part of an integrated whole. This could be defined as a learning strategy that is an integrated set of information processing behaviors according to Biehler and Snowman (1982). Bower (1973b) points out that

> . . . by systematically applying the knowledge we now have about learning, we should be able to improve our skills so that we spend less time memorizing fact. By the strategic use of mnemonics, we free ourselves for those tasks we consider more important than memorization (p. 70).

Purpose of the Study

As indicated, research has shown that mnemonics can improve and facilitate the learning process. This study will examine the effectiveness of using mnemonics involving visual imagery, the story narrative link method, and their association with sound relationships (intervals). There is substantial experimental support for the fact that the narrative story mnemonic can increase retention of word lists above that of an uninstructed control group (Boltwood and Blick, 1970). The question in the study is whether or not the story narrative can increase retention of auditory stimuli involving musical intervals.

An interval is the distance from one note to another note. The traditional method of teaching intervals involves listening, identifying (association with sound), and repetition (rote practice).

Definition of Terms

Memory--ability to store information that has been sensed, perceived, and learned. It also refers to the ability to retrieve that information from storage when needed.

Mnemonic--"aiding the memory." Mnemonic devices are essentially rule-governed systems designed to improve recall. Strategies for using mnemonics may include specific-purpose techniques such as rhymes, patterns, acrostics, acronyms, and more general-purpose systems such as the link, loci, peg, phonetic, and story narrative systems.

Reduction Coding--involves stripping away irrelevant information so as to reduce the amount that needs to be stored such as an acronym (first letter).

Elaboration Coding--involves adding information beyond what is strictly necessary, both verbal and visual, to make the material more memorable.

Story Narrative--can be classified as a general purpose system using elaboration coding both verbal and visual. It is an extension of the use of sentences as mediators in a pair-associate, serial-learning task. One just continues with additional sentences to form a story based on the items you want to hear. This system uses the principles of learning that interact reciprocally.

Visual Imagery--the cognitive process of forming pictures in the mind.

Rote Rehearsal--refers to practice or repetition. Doing something over and over again.

Metamemory--the awareness of the need to remember and knowledge about the importance of selecting methods for remembering something. The knowledge of how one's memory works.

Interval--relation between two notes recognized solely through the ears and brain, i.e., is an effect on the aural perception.

Melodic Interval--is one formed when two notes are sounded in succession.

Harmonic Interval--is one formed by sounding two notes simultaneously.

Assumptions and Limitation

Assumptions

It is assumed the sample size is large enough to closely approximate characteristics of the population. Also, stratified random sampling insures representation of subgroups in the total population.

The data obtained from testing is represented in terms of scores. Linton and Gallo (1975) state that the most common assumptions concerning the nature of score data are:

1. The intervals between scores are equal; that is, differences between scores at one point of the measuring scale are equivalent to the same size differences at any other point on the scale.

2. The scores are assumed to be normally distributed within the population or populations from which they were drawn.

3. The variances of the populations are assumed to be homogeneous. It is therefore assumed that the factorial analysis of variance would be appropriate for this type of data (p. 11).

Limitations

Most of the achieved scores were low suggesting a limitation to the interpretation of results. The inability to schedule more than one session for instruction and testing was a definite limitation. This did not allow for the use of a pre-test with estimated reliability and validity. Without giving a pre-test, it was assumed that both experimental groups could identify intervals with equal accuracy by chance alone. Since the instructions and narration for both methods were taped and subjects had not experienced this task in the past, it was assumed that all subjects would approach the task with neither positive nor negative feelings in relation to it.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Research Since 1965

According to Higbee (1977), much of the really good research on memory improvement and virtually all of the research on mnemonics has been published since 1965. He attributes this revived research interest in mnemonics to the general acceptability of cognitive processes as a legitimate area for research. As a second possible reason why mnemonics may not have been viewed as a legitimate area for scientific inquiry for so many years, he states that they were associated with sensationalism, showmanship, and commercialism. Kail (1979) reiterates that memory research has emerged as an important area of study within experimental psychology. He states that during the 1960's it became apparent that learning could not be studied in isolation from memory and attention was focused, for example, on the manner in which information was stored as it was learned. He examines the development of two broad themes. The first theme is that memory development is not the development of a unitary skill; rather, it represents the development of a diverse assortment of skills and subskills. A second theme is that memory develops not in isolation from other cognitive skills but in interaction with them.

Consequently, an understanding of memorial processing may be necessary to study other cognitive skills.

Legitimacy of Memory Research

Morris (1979) concludes that

> . . . memory is essential for intelligence and creativity. To solve a problem requires the recall of the appropriate components and strategies. There is no point in knowing about something if that knowledge is not retrieved at the appropriate time. Much of everyday life is a form of problem solving, involving comprehension in the light of past experience (p. 52).

Baddeley (1976) points out that the trend over the last 15 years in the field of human memory has been in the direction of an increasing awareness of the complexity of the problem. He gives examples to illustrate this point and then asks, "How can we be sure that we are going in the right direction or in any direction at all?" (Baddeley, 1976, p. 374). His answer is the same as that offered by Neisser (1976), namely, to continue to check concepts and results against observations outside the laboratory. Of the several examples he uses to validate his statement, the following corresponds with Morris' (1979) conclusion. He states,

> In order to measure a person's intelligence, one presents him with a wide range of tasks, each assumed to measure the quantity of either the single faculty of 'intelligence' or a cluster of such faculties, depending on one's theoretical bias. Many of the subtasks used have a major memory component. For example, the Wechsler Adult Intelligence Scale (Wechsler, 1944) involves tests of (1) information, i.e., general knowledge (semantic memory); (2) comprehension (semantic memory); (3) mental arithmetic (working memory); (4) similarities between various verbally presented items (semantic memory); (5) digit span (STM); (6) vocabulary (semantic memory); (7) digit-symbol substitution (STM); (8) picture completion, i.e., detecting the deficiencies in incomplete pictures (visual LTM); (9) block design, i.e., reproducing an arrangement of colored blocks (visual working memory); (10) picture arrangement, i.e., arranging a series of cartoon pictures in an appropriate

> sequence (semantic memory); (11) object assembly, involving simple jigsaw puzzles (semantic visual memory). This does not mean that the WAIS is simply a memory test, but it does suggest that intelligence, as measured by such tests, is very closely related to the functioning of the underlying memory system (Baddeley, 1976, p. 376).

Morris Question Model

As can be seen, memory plays a critical role in the everyday lives of all. Research on memory improvement is an area of psychology that does not need justification to the man-on-the-street. He can see the point of such research but may wonder if psychologists have much to offer him. Morris (1979) proposes the following model for memory improvement, the approach to which will depend upon the nature of the specific situation. An examination of the situation will suggest one of a variety of tactics. (See Figure 1.)

First, is the problem one of remembering to do something (an intention) or remembering a fact? If an intention, little is known about the underlying processes. If the problem is one of remembering facts, then the second question is: Is the problem at the acquisition or the recall stage? In other words, is the issue one of how to learn something to maximize the ease of later recall, or is the problem one of retrieving something already entered into memory? If it is the former then a whole range of techniques may be exploited. If the problem is one of optimizing learning, then the third question is: Is the material to be learned connected and meaningful or disconnected and meaningless? Whichever answer is given the next stage will be to maximize the known factors that influence memory. Where the material is connected and meaningful, this task is relatively easy. If, however, the material is disconnected and meaningless, it will be necessary to find ways of

Intention or Fact?

Intention — ?

Fact — Retrieval or encoding stage?

Retrieval — Personal event or impersonal fact?

- Event — Attempt reconstruct
- Fact — 1st letter cue

Encoding — Meaningful-connected or Meaningless-disconnected?

- Meaningful — Strategies to develop understanding, e.g., SQ3R
- Meaningless — Strategies to add meaning, cues and organization, i.e., mnemonics

Figure 1. Morris Question Model

imposing meaning, supplying interconnections, and providing retrieval cues. For the former case various study skills can be recommended; for the latter case, a range of mnemonic techniques exist that can supply what is missing (Morris, 1979, p. 31). It is the latter case that is the focus of this study and literature review.

Purpose of Mnemonics

Mnemonics can be seen as making use of the properties of the memory system. They do not replace the basic principles of effective learning but are based on the principles of learning. Mnemonics use the principles of meaningfulness, association, organization, visualization, attention, and interest. They also help reduce interference. In addition, the strategies for effective learning may be used along with mnemonics such as SQ3R (Survey, Question, Read, Recite, Review).

Howe and Ceci (1979) state that the aim of most memory training procedures is not to alter basic memory processes, but to introduce plans for deploying the capacities a person already possesses in an organized and coordinated manner that is maximally effective for meeting the demands of a particular task. Higbee (1977) writes that mnemonic systems are not supposed to take the effort out of learning; they are supposed to give you more for the effort you put in. Baddeley and Patterson (1971) comment that most systems form a combination of reduction coding and elaboration. Reduction coding involves stripping away irrelevant information so as to reduce the amount that needs to be stored such as an acronym (first letter). An elaboration code involves adding information beyond what is strictly necessary in order to make the material more memorable. Fundamentally, it enhances the organization and meaningfulness of material being learned. Two basic forms of elaboration coding tend to dominate mnemonic systems: the first utilizes semantic or verbal coding, the second visual imagery.

Strategies for using mnemonics may include specific-purpose techniques such as rhymes, patterns, acrostics, and acronyms, and more general-purpose systems such as the link, loci, peg, phonetic, and story narrative systems. Manning and Bruning (1975) conclude that research needs to investigate further the mnemonic/materials interactions. The nature of the information to be learned is likely to be a major factor in the determination of the effectiveness of mnemonic strategy. Interacting also with the choice of mnemonic strategies are factors underlying individual differences in remembering. These factors may include the possibility of developmental changes in basic capacity and strategies due to age, knowledge, and metamemory.

Story Narrative Mnemonic

Since the purpose of this study was to examine the effectiveness of the story narrative mnemonic in learning musical intervals, the remainder of this review will examine this mnemonic in three ways: first, in light of the principles of learning and individual differences; second, how effective the story narrative is in comparison to other mnemonic strategies; third, in light of memory research concerning musical intervals.

In Light of the Principles of Learning

The story narrative can be classified as a general purpose system using elaboration coding, both verbal and visual. It is an extension of the use of sentences as mediators in a paired-associate, serial-learning task; one just continues with additional sentences to form a story based on the items one wants to remember. This system uses the principles of learning that interact reciprocally. Meaningfulness, for example, can be derived from organizational rhymes, patterns, category clustering, chunking, associations, visualization, and so on. Organization is enhanced through visualization and association, which is basic to all the mnemonic systems. Mnemonic systems force one to concentrate on or attend to the material in order to form pictures and associate them. They tend to be interesting because they make material meaningful and involve visual imagery.

Research supporting meaningfulness and organization shows that words are easier to remember than nonsense syllables. Concrete words are easier to remember than abstract words. Words grouped into meaningful categories are easier to remember than words given in meaningless order. Sentences are easier to remember than words in ungrammatical order. And well-organized paragraphs are easier to remember than disorganized ones.

Supporting the above statements are some basic research examples. First, Ebbinghaus (1976) devised the nonsense syllables with the specific aim of minimizing the role of meaning in memory. As Prytulak (1971) has found, people who participate in experiments with nonsense syllables sometimes try various personal strategies to give meaning to a list of words so they can learn them easier. They may try converting a nonsense syllable into a meaningful word by using a substitute word (Hawk for Hok), adding a letter (Tack for Tac), or substituting a letter (Cut for Kut). Others try organizing material into meaningful units or looking for a pattern. Baddeley (1976) summarizes this research by stating that largely as a result of the variability in performance resulting from this complex array of strategies, work using nonsense syllables has become less and less common over the past 10 to 15 years. Second, Paivio (1971) theorized that concrete material (such as pictures of familiar objects) and concrete words (such as horse, bottle, water) are remembered better than abstract words (for example, deduction, justice, theory) because the former can be encoded two ways--as images and as verbal labels--whereas abstract words are only encoded verbally. Thirdly, Bousfield (1953) studied the recall of a 60-item list comprising 15 animals, 15 names, 15 professions, and 15 vegetables presented in scrambled order. Despite the random order of input, subjects tended to recall items in clusters; having recalled one animal, a subject was more likely next to recall another animal than to recall an item from another category. Fourth, an example of research involving the role of syntax in memory was that conducted by Marks and Miller (1964) using real words combined in each of four ways:

1. Normal sentences--noisy parties wake neighbors sleeping,

2. Anomalous sentences, which are made by combining the appropriate parts of speech from each of several sentences which are grammatical, though intended not to be meaningful--noisy flashes emit careful floods,

3. Anagram strings comprising words from the sentences in scrambled order--neighbors sleeping noisy wake parties, and

4. Word lists compiled from the anomalous sentences and presented in random order--floods careful noisy emit flashes.

Subjects listened to five sequences from one of the four conditions and then tried to reproduce them. The normal sentences proved to be much easier than either the anagram string or the anomalous sentences, which in turn were easier than the random word lists. Fifth, similar results have been found with prose materials. Myers, Pezdek, and Coulson (1973) told subjects to read a passage that describes the various characteristics of five fictitious countries and then attempt to recall as much of the information as possible. The passages to be read were written in an organized or random format. In the organized version all attributes of country A were discussed in one paragraph. The second paragraph enumerated all the attributes of another country and so on. Such an organizational structure is similar to a word list where all the words from a conceptual category appear consecutively. In the randomly organized passage, each paragraph consisted of five sentences chosen at random from the total number available. Subjects who read the organized passage showed a higher degree of category clustering and greater recall of facts than the subjects who read the random version.

Visual imagery plays a central role in mnemonic systems but not all mnemonic techniques involve visual imagery. Verbal mediators are frequently used in paired-associate tasks. A large portion of the research on mental imagery has also been conducted in paired-associate learning. In paired-associate learning (PAL), used by Paivio (1971) and others, subjects are shown a set of word pairs and instructed to learn them so that when one member of the pair is presented they can correctly recall or reorganize the other pair member.

Many studies have compared the effectiveness of verbal and visual mediators. Some studies have found no significant differences between visual and verbal mediators. Bower and Winzenz (1970) compared four paired-associate learning strategies: repetition, reading a sentence connecting the stimulus and response words, generating such a sentence, and linking the two words in a composite visual image. They found that instructions to construct a sentence linking the two words are almost as good as imagery instructions and lead to better retention than merely reading a linking sentence, which in turn is better than rote repetition. The evidence therefore suggests that semantic and imagery instructions both facilitate LTM.

In the last 20 years neurological evidence has emerged to support the speculation of dual memory processes (Paivio, 1971; Wittrock, 1975; Springer and Deutsch, 1981). It seems one process employs language and language processes and is related to the left hemisphere and its accompanying cognitive processes. The other employs visual processes or visual imagery and is related to right hemispheric processes.

It also appears that the method of encoding, verbal or visual, is an interrelated function of the nature of the input and the preferred mode of the individual. Easily verbalizable material, even if presented visually, will tend to be stored verbally. On the other hand, easily visualizable material, even if presented verbally, may be stored visually (DeRenzi, 1968; Richardson, 1980). Still another factor to emerge from the hemispheric brain research is that the hemispheres are able to process input in different ways simultaneously and complementarily. Zaidel and Sperry (1974) found that connected hemispheres performed better on memory tasks than either hemisphere alone, no matter what the nature of the input. They concluded that interhemispheric communication and cooperation is an important element of optimum memory processing.

Gazzaniga and Sperry (1967), after testing commissurotomized patients, concluded that the left hemisphere could both recognize and actively produce speech, whereas the right hemisphere had passive speech recognition but could not talk. In other words, it appears that both hemispheres can understand and react intelligently to language, but only the left can produce it in speech or writing. It was found that if an object name is flashed to the left hemisphere and the person has to tactually find that object with his left hand, he cannot perform; in this case he can name what he is looking for, but his left hand cannot find it. To solve this problem with the left hemisphere, patients say aloud or whisper the name of the object. That auditory feedback can then be recognized passively by the right hemisphere, which can then guide the left hand to the correct object. Therefore, this would seem to support the validity of implementing and using the story narrative since the system activates both verbal and visual processes.

In order to process stimuli either visually or verbally one must pay attention or attend to the stimuli. One must get something before one can forget it. Attention is influenced by interest. Persons pay attention to those things in which they are most interested. A large number of experiments with visual imagery have investigated other attention-getters using novel, bizarre, or incongruous stimuli. Persons tend to sit up and take notice of things that violate their expectancies.

Research (Higbee, 1979) suggests at least three strategies that may be used to make visual associations effective. First, form a visual image of the two items interacting with each other. For example, if one associates "dog" and "broom" it would be better to picture a dog sweeping with a broom than to picture a dog standing by a broom. Second, picture the image as clearly and vividly as possible. A vivid visual image is one that is clear, distinct, strong, emotional, colorful, or forceful. For example, actually try to see the dog sweeping with the broom making the picture detailed. What kind of dog is it? What kind of broom? Where is he sweeping? What is he sweeping? In studies where people have learned concrete sentences or paragraphs that described events with high or low vividness, the vivid ones were recalled better than non-vivid ones (Anderson and Hidde, 1971; Holmes and Murray, 1974). Third, use bizarre associations. For example, a dog riding a broom like a witch. Senter and Hoffman (1976) found that bizarre imagery is not more effective than plausible imagery. When bizarreness does help, it is likely because of incorporating other factors which help memory, such as interaction, vividness, uniqueness, and extra time spent on an image. However, these factors also help make plausible images more memorable. Therefore, evidence can be found that provides strong support for interaction, some support for vividness, and no support for bizarreness.

In light of the principles of learning, the story narrative mnemonic system can aid the memory through dual processes, organizing stimuli, and making stimuli meaningful. Much of the study concerning dual processes has been conducted in pair-associate learning. Association is basic to all the mnemonic systems. Also, neurological evidence has emerged to support the speculation of dual memory processes. Attention and interest can be enhanced by the way in which associations are made. Although studies have yielded mixed results, some studies have found that both visual and verbal mediators tend to be more effective if subjects think them up themselves than if they are given by the experimenter (Bower, 1973a; Wittrock, 1977; Richardson, 1980).

Individual-Developmental Differences

In addition to the principles of learning, the effectiveness of the story narrative may depend on individual differences. Most of the available information concerning individual differences in the detailed characteristics of human memory comes from developmental research comparing performance by children at different ages. Howe and Ceci (1979) have distinguished four categories of possible causes of age-related improvements in memory. First, a possibility of capacity changes in the basic physiological hardware of memory systems. Although, available evidence suggests that changes in basic memory capacities after early childhood are small or non-existent. The second category refers to the strategies individuals use when attempting to remember. The third kind of change is in the knowledge individuals possess concerning the materials being remembered. Fourth, there appear to be considerable age-related changes in the extent to which children can deliberately adopt plans to help them remember things. Flavell (1971) introduced the term "Metamemory Processes," which refers to an awareness of the need to remember and knowledge about the importance of selecting effective methods for remembering something.

Recent research has offered no firm support for the view that increases in basic capacities for retaining or processing information form a major cause of developmental memory changes after early childhood. Evidence appears to suggest that developmental changes in memory can be adequately accounted for by age-related improvements in the use of strategies and metamemory processes and by differences in knowledge about items to be remembered (Harris, 1978).

Strategies can have marked effects upon performance. The strategies that a person acquires can take many forms such as labeling, elaborating, various kinds of coding processes, using mediators, organizing items, rehearsal, and various other planned activities. For example, kindergarten pupils rarely engage in spontaneous rehearsal and do not adapt rehearsal strategies to fit environmental circumstances (Hagan and Stanovich, 1977). By the age of seven simple rehearsal strategies are typically used. From the age of 10 rehearsal becomes more like that of an adult. Several items may be grouped together and rehearsed as a set. Use of visual imagery as a strategy varies with age. Preschool and kindergarten children do not generate images spontaneously or in response to a direction to do so. However, if the learning material is presented pictorially or if actual objects are used, they learn much more than if written materials are used. Even greater learning may result from allowing young children to manipulate the objects themselves or act out the pictured interaction. Presumably, this increases the quality of the image. Five to eight-year old children need no such prompts. They profit from simply being told to form interacting images in their mind. Older children and adults often spontaneously use imagery whenever they are confronted with a learning task (Levin, 1976).

Developmental increases in children's knowledge provide a further age-related factor that contributes to remembering. Some strategies can only be undertaken if the individual possesses appropriate knowledge such as attributes of items to be grouped into categories. Also the more a person knows about meanings of an item stored in his memory the more easily the item can be retrieved. It is like when a child's knowledge enlarges, the number of routes via which a particular item may be located increases. The constructive view of memory as discussed by Paris and Lindauer (1977) implies that knowledge retained over time undergoes progressive and continuous change from the moment it is first apprehended. The representation is a dynamic integration of constructed meaning. But the information that is retained and the schemata to which it is assimilated both change as a consequence of the incorporation of one into the other. In other words, the memory system stores the results of our making sense of our experiences rather than the experiences themselves (Morris, 1979). Several studies have shown that increases in knowledge are accompanied by more accurate remembering through the use of inferences--estimates about what is to be remembered made on the basis of what is known to be true. The greater the degree of knowledge an individual possesses in relation to what he is trying to recall, the greater the probability that inferences will be correct. Paris and Upton (1976) found that when children listened to stories and were then questioned about the contents, older children not only remembered more accurately than younger subjects, but they also obtained the highest scores on questions that involved inferred presuppositions and consequences of the stories.

Metamemory, the knowledge of how one's memory works, is the fourth category showing developmental differences. Kail (1979) has organized metamemory research into several categories, one of which is the use of strategies. Older children are more likely to recognize that organizational properties of a learning task affect memorability. Kreutzer, Leonard, and Flavell (1975) observed that most ten and eleven-year olds but very few six and seven-year olds realized that word pairs made of opposites would be easier to learn than pairs of random words. Older children were also more likely to perceive that presentation of items in narrative form would lead to increased remembering. Brown and Smiley (1977) found that older children can identify those parts of a story that are more important to the theme and that will most likely be remembered, but younger or less academic students cannot. Mackworth and Bruner (1970) show that when children below the age of six are presented with something that requires visual processing, they generally scan only a limited part of the stimulus and that part in a rather haphazard manner, failing to utilize all the existing information. Another category listed concerned recognition and recall. Flavell (1977) found that children aged seven to ten years were much better at estimating when they were ready to recall items accurately than were four to six-year-olds. Another study by Kreutzer, Leonard, and Flavell (1975), showed that young children are aware of savings produced by relearning and of the fact that familiar material will be learned faster than less familiar material. These examples are just a few of a wide range of research concerning metamemory. For the most part, however, it has been confirmed that metamemorial knowledge develops with age and experience. Also, when metamemory and memory training are combined, young children's memory performance shows more of an increase than if memory training alone is provided (Kail, 1979). Therefore, when considering the effectiveness of the story narrative system as a memory aid, developmental readiness and ability need to be taken into account.

Comparison to Other Mnemonic Techniques

If instruction in mnemonic strategies and metamemorial processes can facilitate performance, then the next question to consider is how effective the story narrative is when compared to other mnemonic techniques or none at all. The following studies show the effects of specific instructions to follow certain strategies.

Bower and Clark (1969) had subjects learn 12 serial lists of 10 nouns either by study and rehearsal or by linking them together to form a story. On immediate recall, lists were remembered virtually perfectly under both conditions, but when subsequently asked to recall all 12 stories the narrative group scored 93 percent correct, compared with 13 percent on list recall for the rote rehearsal group.

Again, as cited previously, Bower and Winzenz (1970) compared four paired-associate learning strategies: repetition, reading a sentence connecting the stimulus and response words, generating such a sentence, and linking the two words in a composite visual image. Sentence generation and imagery were comparable in efficiency, both being considerably more effective than either reading a linking sentence or rote repetition. Subjects for both the Bower and Clark (1969) and the Bower and Winzenz (1970) experiments were undergraduates fulfilling a service requirement for their introductory psychology courses.

Murray (1974) attempted unsuccessfully to replicate and extend the results of Bower and Clark (1969). The major difficulty in his early experiments was the failure of the narrative group in constructing narratives when instructed to do so. To insure that narrative subjects would create such narratives when their yoked control subjects would not, the experiment required occasional reports of the narratives constructed for particular word lists. Additionally, frequency and associative strength of words were controlled for each list. Frequency of occurrence was determined by the use of Thorndike and Lorge tables. The tables are lists of words in which each word is followed by a record of the frequency of occurrence in Standard English reading matter. Associative strength, defined as the average relative frequency with which all items in a list tend to elicit all other items in the same list as free associates, was determined by using lists of different interitem associative strength. Sixteen lists of 10 nouns were presented to 36 subjects. Four of the 16 lists were narrative report lists used only to control narrative subjects following instructions. Thirty-six volunteer female undergraduates from introductory psychology courses were assigned to two groups. Eighteen of these subjects were randomly assigned to a narrative group and 18 to a control group. Each control subject was then randomly yoked to a narrative subject. Control subjects received a study time equal to that of their yoked narrative subjects. Subjects were required to recall the lists immediately after learning, at the end of the session, and either 7, 14, or 28 days later. Significant differences were obtained between the two study groups on a session recall test and on the delayed recall interval tests but not on immediate recall test. On the session recall, the narrative subjects recalled 72 percent of the total words while the control subjects only 33 percent. Murray concluded that constructing stories about words does not seem to affect immediate recall but significantly improves recall after the study of a large number of words. Statistical significance was also obtained among lists of different interitem associative strength. Recall was greater from lists of high interitem associative strength than from either zero or low interitem associative strength.

Manning and Bruning (1975) investigated the effects of two mnemonic strategies, the First-letter and Descriptive-story, with acquisition and recall of concrete and abstract words. Additionally, imagery level of peg words within the first-letter technique was varied. A hook or peg is usually a common noun or familiar location with which the new word in associated. Ninety subjects were drawn from volunteer students in introductory psychology and educational psychology classes at the University of Nebraska at Omaha during the spring and summer terms of 1973. The 90 subjects were randomly assigned in groups of 15 to one of the following treatment combinations: (1) First-letter High Imagery mnemonic/abstract word list, (2) First-letter High Imagery mnemonic/concrete word list, (3) First-letter Low Imagery mnemonic/abstract word list, (4) First-letter Low Imagery mnemonic/concrete word list, (5) Descriptive-story mnemonic/abstract word list, and (6) Descriptive-story mnemonic/concrete words list. Initial instructions for all conditions were for subjects to learn a list of 16 words over 10 trials as seen on a slide projector. Depending upon the treatment group to which the subject had been assigned, the remaining instructions were varied. Subjects were instructed to return the next day for a follow-up at which they were requested to write as many of the words from the original list as they could remember plus explain the technique used. Data were analyzed for 75 subjects since some failed to return for the 24-hour follow-up or follow instructions. A 3x2x10 factorial analysis of variance, with repeated measures on the last factor, was used to analyze the data collected for the 10 learning trials. A 3x2 factorial analysis was employed to analyze the 24-hour recall scores. The main effect for type of mnemonic, type of word list, and the interaction between these two variables across the 10 learning trials or the 24-hour recall was not significant. Analysis of the simple effect of type of mnemonic over the 10 trials yielded a significant performance difference among the treatments on the first three trials. The Descriptive-story technique was significantly superior to the

First-letter with High Imagery ($p < .01$), while no significant difference between the two First-letter mnemonic techniques was noted. Computation of the simple effects for the 24-hour recall yielded significant effects of type of mnemonic for the concrete and abstract word lists. Whereas the Descriptive-story technique was the most effective strategy for recalling concrete words, it was the least effective in aiding recall of abstract words.

Boltwood and Blick (1970) designed two experiments, one to determine what mnemonic techniques subjects would employ in learning a list of 19 unrelated nouns and the other to compare the three most common techniques used in the first experiment. All nouns in the list began with a different letter of the alphabet and were characterized by low frequency of occurrence according to Thorndike and Lorge (1944) word-frequency tables. In order to minimize conceptual relatedness among the words, each word was a member of a different one of Cohen, Bousfield, and Whitmarsh's (1957) conceptual categories. Experiment two involved students from three general psychology classes at the University of Richmond, Richmond, Virginia. Three groups applied the first-letter, clustering (C) (conceptual categories), and descriptive-story (DS) techniques, and recall was compared to a no-mnemonic (simple repetition) condition. No mnemonic proved most effective at the immediate retention interval. If was concluded that the DS and C techniques proved to be significantly more effective as mnemonics for the one-week interval, but only the DS technique was effective at the eight-week retention interval. Boltwood and Blick hypothesized that the DS technique was effective because it resulted in a meaningful syntactical arrangement of the words and could be effectively employed without previous experience in its use.

Rust and Blick (1972) investigated another dimension to the previously cited publications. They presented the first-letter and descriptive-story techniques to two experimental groups, while a control group received instructions in a no-mnemonic (simple-repetition) technique, following rote memorization by all three groups of a free-recall task involving 14 nouns. Three similar general psychology classes involving 66 subjects at the University of Richmond were used. There were no significant differences in recall among the three conditions at an immediate, one-week, or eight-week interval. It was concluded that if mnemonic techniques are to have a facilitating effect, it is imperative that they be presented at the time of original learning of the material. They cited two experiments, one by Tulving and Osler (1968) and the other by Hudson (1969) to support their conclusion. As shown by Tulving and Osler (1968), changing the retrieval cue paired with the word between input and output will interfere with retention of the word. Rust and Blick (1972) concluded that any cues formed by subjects in association with the list of words to be remembered interfered with the experimental-imposed cues prior to output, or vice versa. Hudson's (1969) findings involved clustering words into categories and subjects were given the names of these categories. The group receiving this information after the presentation of the word list recalled fewer words than either group receiving information before or no information. An additional question was considered by Rust and Blick (1972) concerning the effect upon retention of mnemonics that are constructed by the experimenter as opposed to mnemonics that are made up by the subjects. They conclude that there was no evidence in this study to suggest that experimental-constructed mnemonics are less effective in aiding retention than no mnemonic at all.

Finally, a study using 24 kindergartners was conducted by Gallimore et al. (1977). Students were blocked by Wechsler Preschool and Primary Scale of Intelligence (WPPSI) IQ scores and randomly assigned to one of three treatment conditions-elaboration (story), rehearsal, and control. The items to be learned were 12 names of shapes ranging from easy to intermediate to difficult. These items were tested immediately after presentation (short-term retention), two hours later (immediate-term retention), and one, two, and three weeks later (long-term retention). Shapes were presented by a slide-cassette synchronized program holding time allotted and behaviors required of students (tracing the shape, and saying its name) constant across all three experimental groups. The elaboration condition used stories to link shape name to a common object. For example, this condition used a story to link the shape square to the object television. The rehearsal condition traced and verbalized each shape name as did the other groups and were instructed to keep saying its name "out loud" until the next shape came on the screen. The control condition, after hearing the shape's name on the tape, simply traced each shape and said its name as it appeared on the screen. The results indicated that initial acquisition was complexly affected by the experimental manipulations as a function of IQ and task experience (week effect). In an elaboration instructional paradigm, less bright children may learn less initially, but what is learned tends to be retained longer. Elaboration helps higher IQ children to learn more initially as well as faster giving better long term retention.

Memory for Musical Intervals

As in the last experiment reported in the previous section, this study proposes to use the story narrative to link auditory and written musical intervals to common songs known by the subject. A common example of a mnemonic associated with music reading is the acrostic, Every Good Boy Does Fine, to name the lines in the treble clef. But as far as can be found, no research has been conducted relating the story narrative or any other mnemonic device to the recognition, learning, and retention of musical intervals.

In her introduction to memory and attention in music, Deutsch (1977) summarizes the research so far:

> It is clear from general considerations that musical memory must involve a highly complex and differentiated system, where information is retained simultaneously at many levels of abstraction. A detailed investigation of this system is only just beginning; and so far it has focussed almost exclusively on memory for pitch, or for abstractions based on pitch information (p. 95).

Henson (1977) also discusses that musical activity depends on intact, efficient memory processes. He writes:

> There are obvious limits to what the neurological sciences can achieve in understanding or explaining musical experience. The great difficulty in the scientific study of the arts is that human perceptions of qualities and patterns is far ahead of anything which science can apprehend at the present time; and with perception comes the emotional response which is quite undefinable in neurological terms (p. 16).

Focusing on this study, the remaining research will concern intervals--their recognition and retention in memory. According to Lloyd and Boyle (1963, p. 125) an Interval is defined as a relation between two notes recognized solely through the ears and brain, i.e., is an effect on the aural perceptions. A melodic interval is one formed when two notes are sounded in succession, whereas a harmonic interval is one formed by sounding two notes simultaneously. Since intervals are formed by two pitches several hypotheses were considered by Deutsch (1977) concerning the influences acting on pitch memory in storage. First, pitch memory simply decays with time. Second, pitch information is retained in a general system which is limited in terms of the number of items it can hold simultaneously. Third, such information is retained in a specialized system whose elements interact in a specific fashion.

One experiment by Deutsch (1977) showed a substantial decrement in pitch recognition when other notes are interpolated during the retention interval. This occurs even when instructions are given to the subjects to ignore the interpolated notes. Subjects in this experiment were selected for obtaining a score of 100 percent correct in comparing pairs of notes which were separated by a silent interval of six seconds. The pitches were either the same or differed by a semitone. The same pairs were again presented but this time eight notes were interpolated during the retention interval. With 50 percent correct representing chance performance, the subjects produced an error rate of over 40 percent.

Deutsch (1970) then tested various hypotheses concerning why the interpolated notes produce a memory loss. One hypothesis was that these notes distract the listener impairing his ability to concentrate on the note he is trying to remember. Consequently other interpolated materials which distracted would have the same effect. Another hypothesis suggested that there is a general memory store into which pitch information is entered along with other information and is limited in the amount of information it can accommodate. Thus, other interpolated information which is remembered should impair pitch recognition. A third hypothesis suggested that pitch is retained in a specialized system. To test these hypotheses, subjects made pitch recognition judgments under three conditions. First, subjects had to recognize a note following a retention interval of five seconds during which six notes were interpolated. The second condition used six spoken numbers instead of notes between the notes to be compared. In both conditions the subjects were to pay no attention to the intervening items. In the third condition, numbers were interpolated and subjects were asked to recall both numbers and notes. The results showed that the interpolation of notes caused a substantial decrement in pitch recognition. In the other two conditions involving numbers only a small decrement occurred. Deutsch concluded that pitch memory loss due to interpolated notes is not based on attention distraction, nor on displacement of material in some general memory store of limited capacity. The evidence suggests that there exists a specialized system for the retention of pitch information.

Deutsch (1970) states that although little formal investigation has been made into the influences acting on other musical attributes in storage, one can speculate from the principles uncovered in the case of pitch. One such speculation can be made in the case of simultaneous and successive intervals. This would be that memory is the function of a continuum the elements of which are activated by simultaneous or successive presentation of tone pairs and are arranged according to the size of the ratio between the component frequencies. Specific facilitative and disruptive effects can take place along this continuum, analogous to effects found in absolute pitch memory. Deutsch (1969) further proposes that abstraction of features derived from pitch is based on successive levels of convergence. This assumes that pitch information is abstracted along two parallel channels, each of which consists of two levels of convergence. The first channel is concerned with abstraction of relational features. First-order units of specific pitch are linked in groups of two and three to second-order units of specific intervals and chords. Second order units further respond to simultaneous stimulation, ascending intervals, and descending intervals. These second-order units are then linked to third-order units in such a way that all units activated by notes standing in the same relationship are joined. The second channel abstracts information concerning the position of a note within the octave, and also mediates inversion of chords.

Deutsch (1978) examined whether memory for harmonic intervals was subject to the same types of interactive effects as memory for absolute pitch values. Thirty-four undergraduates at the University of California served as subjects for this experiment. They were selected on the basis of obtaining a score of at least 80 percent correct on a tape containing intervals formed by interpolated combinations chosen at random. Tones for the tape were generated by two Wanetek oscillators controlled by a PDP-8 computer. Subjects compared the pitches of two temporally separated tones. The standard (S) and comparison (C) tones were either identical in pitch or they differed by a semitone. They were both accompanied by the same lower pitch tones. Thus when S and C tones were the same pitch the interval size was the same. The interval size differed when S and C tones differed. S and C tones were separated by a retention interval during which six extra tones were interpolated. Tones in the second and fourth serial positions of the interpolated sequence were also accompanied by tones of lower pitch. Subjects were instructed to listen to the upper tone of the S combination and ignore the lower tone, to ignore all the intervening tones, and then to judge whether the upper tone of the C combinations was the same or different in pitch from the upper tone of the S combination. They wrote their response by writing "S" (same) or "D" (different) on paper. There were three conditions in which S and C tones were identical and three conditions in which S and C tones differed in pitch. In Condition S1, the I (interpolated) combinations formed intervals that were identical in size to the interval formed by the S combination. In Condition S2, half the I combinations were a semitone larger and half were a semitone smaller than the S combination. In Condition S3, the intervals were chosen at random from within an octave but not repeating the other two conditions. It was found that pitch recognition judgments vary systematically as a function of the relationship between the intervals formed by I combinations and the interval formed by the S combination. When the intervals formed by the interpolated combinations were identical in size to the interval formed by the first test tone combination, the error rate was lower than when the sizes of the intervals formed by the interpolated combinations were chosen at random. Further, when the intervals formed by the interpolated combinations differed in size by a semitone from the interval formed by the first test tone combination, the error rate was higher than when the sizes of the intervals formed by the interpolated combinations were chosen at random. This experiment, therefore, demonstrates the presence of both consolidation through repetition and also similarity-based interference in memory for harmonic intervals. This indicates that the system retaining such information is similar in organization to the system retaining absolute pitch values. In this system when a tone of identical pitch to the first test tone is included in an intervening sequence, the effect on memory is facilitatory rather than disruptive. However, in another experiment (Deutsch, 1975) it was found that this consolidation effect is very sensitive to the serial position of the repeated one. It appears that consolidation takes place along a continuum that is organized in terms of order independent of time.

Plomp, Wagenaar, and Mimpen (1973) also conclude from their results that interval stimuli are arranged along a continuum that is organized in terms of interval size. They found that confusions were made on the basis of interval size. Their experiment did not support the hypothesis that the human ear is provided with some sort of frequency-ratio detector.

Two other studies suggest that subjects do retain information about absolute intervals as well as contour and pitch in long-term musical memory. White (1960) had subjects recognize familiar tunes which were transformed in various ways. Subjects were correct 94 percent of the time when the tune was unmodified. This dropped to about 80 percent when the overall pitch was changed and to about 50 percent when the contour was maintained but the intervals between successive notes were transformed in a nonlinear way. Similar results were reached by Dowling and Fujitani (1971). They had subjects recognize familiar tunes under various distortions and noted that the recognition rate fell from 99 percent to 66 percent correct when the absolute intervals between successive notes were varied, even though contour was maintained. Dowling (1978) found that intervals are easier to abstract from melodies that can be encoded in terms of a tonal scale. Further, Barlett and Dowling (1980) found that melodic intervals, difficult to encode with atonal materials (experiment 2), are encoded relatively well with tonal melodies so that they are recognized in transposition. Attneave and Olson (1971) also found that subjects could transpose a familiar tonal melody much easier than to transpose isolated intervals. From these studies it was found that contour is easy to extract from a melody but no easier to remember than intervals. Interval information is difficult to encode, and subjects are easily confused about it in immediate tests. However, it seems that interval (or scale step) information, once stored in memory, fades slowly. Essentially, though, the research so far in music has concluded that music is hierarchial, not just a single hierarchy but multiple interacting hierarchies.

From the neurological point of view, research has examined the possibility of a dominance for musical faculty. Evidence for the dominance of the right hemisphere in the perception of musical passages has been largely provided by the use of the dichotic listening technique. The first study of this kind came from Kimura (1964), who presented to a group of normal subjects different portions of baroque melodies. The subjects were asked to recognize the musical passages. It was found that more selections were correctly identified when they were presented to the left than to the right ear. This was interpreted as a left ear advantage, and hence a right hemisphere superiority for the perception of melodies. Conflicting reports have been made by Gordon (1970) and from Bever and Chiarello (1974) using this method.

Other techniques used have been the choice reaction time procedure (Fry, 1970), electrocephalograph (McKee, Humphrey, and McAdam, 1973), and Wada (Gordon and Bogen, 1974). All of these demonstrated a right hemisphere specialization for the perception of music. The reaction time procedure measures rapidity of response and is based on the assumption that speed of reaction can be used as a measure of ear superiority and hence of cerebral dominance. The authors using the electroencephalographic technique recorded relative bilateral alpha activity in the temporo-parietal regions of the two hemispheres while the subjects were engaged in either a musical task or one of three linguistic tasks of varying difficulty. The Wada technique shows singing or speech deficits after injections of sodium amylobarbitone into the right or left carotid.

Wyke (1977) summarizes recent studies using the techniques described. They include Darwin (1969), Gordon (1970), Spellacy (1970), Spreen, Spellacy, and Reid (1970), Halperin, Nachshon, and Carmon (1973), Nachshon (1973), Haydon and Spellacy (1973), Robinson and Solomon (1974), and Kallman and Corballis (1975). Wyke (1977) states that at the present there is no evidence to justify the view that the right hemisphere is dominant for all musical tasks. Neither the right nor the left hemisphere alone exhibits an unequivocal cerebral specialization for the components of musical cognition.

Another aspect of musical research has investigated the sequence of human development which seems to follow the hierarchy of features derived from pitch. Dowling (1982) reviews this development from infancy through school age years. In early infancy the child can reproduce single pitches and can notice a change of melodic contour. Investigating this age of development have been Renesz (1954), Shuter (1968), Melson and McCall (1970), Ostwald (1973), Kinney and Kagan (1976), Chang and Trehub (1977), and Kessen, Levine and Wendrich (1979).

Around the age of five or six the child can organize songs around stable tonal centers (keys) but does not yet have a stable tonal scale system that can be used to transpose melodies accurately to new keys. A study by Bartlett and Dowling (1980) used familiar melodies and tonal imitations, retaining the same contour but with changes of interval size, transposed to near and far keys. They found that five-year-olds could distinguish near from far keys but did not have the ability to detect changes of interval sizes in the tonal imitations. In comparison, eight-year-olds can use both key distance and interval changes to reject a comparison stimulus. A similar result found by Imberty (1969) was that seven-year-olds could notice sudden changes of key in the middle of familiar tunes and that eight-year-olds could tell when a melody had been switched from the major to the minor mode. The scale system develops during the elementary school years but little has been studied between these years and adulthood.

Finally, research on intervals indicates that certain melodic intervals are characteristically more difficult than others to identify. This has been investigated in two studies by Jeffries (1967, 1972). One study tested subjects' validity in rating 24 ascending and descending melodic intervals of the octave based on their judgments as to how often they had heard or experienced these intervals in music. An interval count was taken by Jeffries of the frequency of occurrence of 24 interval types found in 53 current and standard popular vocal music scores. Another objective of the study was to determine if the ascending interval types occurred in significantly greater numbers in the interval count than the descending interval types. The subjects were 214 college students comprising two groups to rate the 24 ascending and descending melodic intervals of the octave individually on a 10-point scale. Group 1 rated the intervals presented on tape on the basis of how familiar each interval sounded. Group 2 rated the same intervals on the basis of how _frequently_ they thought they had heard or experienced each interval type in music. Results showed that subjects agreed closely in their familiarity and frequency mean ratings. Results also revealed that subjects rated the ascending intervals as being significantly more familiar and frequently heard as a group than the descending intervals as a group. The results also indicated a significant inverse relationship between interval count and rate of error. The higher the count was for particular intervals, generally, the lower the error rate for subjects learning to identify these intervals. This study may point to the possibility that people can judge quite accurately the frequency with which they hear the various melodic intervals in music.

The second experiment was concerned with the teaching of melodic interval dictation using programmed learning procedures and the effects of immediate knowledge of results (KR) for confirming interval judgments. Subjects were selected from 235 students given the first three tests of the Wing Standardized Tests of Musical Intelligence. Twenty-four were chosen who made a total point score between 60 to 65 out of a sum of 80 points. Upon completion of training according to four schedules, each subjects was given a posttest, a transfer test, and retention test. The posttest was given the school day following completion of training, the transfer test the next day, and the retention test two weeks later. The schedules were as follows:

> Schedule A: intervals presented in a rank order of increasing difficulty using immediate KR.
>
> Schedule B: intervals presented in the same order of difficulty with delayed KR.
>
> Schedule C: intervals presented in a random order of difficulty using immediate KR.

Schedule D: intervals presented in the same random order of difficulty with delayed KR.

Subjects assigned to Schedule D made the highest percentage scores while those assigned to Schedule B made the lowest. An analysis of variance test applied to errors during training revealed no significant difference in scores at the 5 percent level between (a) ordered versus random presentation; (b) immediate KR versus delayed KR; and (c) KR versus order of presentation. It was not until the retention test that the interval order was highly significant beyond the 1 percent level, the mean score for the random presentation being higher than that of the ordered presentation. A further breakdown of error rate for subjects assigned to each schedule revealed that, during training and on the tests, the augmented fourth, minor seventh, and minor sixth were consistently among the four most frequently missed intervals. Therefore, from this study it can be seen that some intervals are easier or harder to recognize and remember than others.

Summary

Summarizing, the review of the literature shows that most of the research on mnemonics has been published since 1965. It was pointed out that memory is essential for intelligence and creativity. The Morris Question Model then narrows the focus of study to mnemonics that make use of the properties of the memory system. They do not alter basic memory processes, but introduce plans for deploying the capacities which a person already possesses. Most systems form a combination of reduction coding and elaboration. Mnemonics can also be classified into specific-purpose techniques or general-purpose systems.

The story narrative mnemonic is a general purpose system using elaboration coding both verbal and visual. This mnemonic was examined in light of the principles of learning, which include meaningfulness, organization, and visual imagery. It was further discussed in terms of dual memory processes--verbal or visual modes of encoding, attention, interest, and association. The system was then examined in terms of individual differences. Possible causes of age-related improvements in memory are viewed in four categories: capacity changes, strategies used, knowledge possessed, and metamemory processes. Specific studies were then discussed which compare the story narrative to other mnemonic techniques.

Finally, memory for musical intervals was investigated in four ways. First, the evidence suggested that there exists a specialized system for the retention of pitch information. It was speculated that memory for intervals is the function of a continuum, the elements of which are activated by simultaneous successive presentation of tone pairs and are arranged according to the size of the ratio between component frequencies. It was concluded that music is hierarchical, not just a single hierarchy but multiple interacting hierarchies. Second, research has examined the possibility of a dominance for music faculty and concluded that neither the right nor the left hemisphere alone exhibits an unequivocal cerebral specialization for the components of musical cognition. A third area of investigation was the sequence of human development which seems to follow the hierarchy of features derived from pitch. Fourth, research on intervals indicated that certain melodic intervals are characteristically more difficult than others to identify.

The information found in this section has provided the understandings and insights necessary for the development of a logical framework into which the proposed problem fits. The review has shown the research that has been done and needs to be done as far as mnemonics and musical intervals are concerned. Nothing was found by the researcher that combines the areas of music and mnemonics. This indicated to the writer a basis for justification of this study. The review also pointed out certain research strategies, specific procedures, and measuring instruments which have and have not been found to be productive. It was discovered that studies investigating the story narrative and musical intervals involved adults subjects with the exception of the Gallimore study (1977). Therefore, the information found relating to individual-developmental differences was helpful in determining the grade levels to be used. Grades one and two were not included in this study due to students' lack of awareness of how to employ the various control processes such as attention, rehearsal, and encoding. Also, it was found that younger children do not have the ability to detect changes in interval size.

Research pertaining to musical intervals indicated how they might be encoded and recalled. Results suggested that interval stimuli are arranged along a continuum that is organized in terms of interval size. Also, interval studies revealed that certain melodic intervals are characteristically more difficult than others to identify. This information was considered in determining what, how many, and sequence of intervals to be included in this study. Several studies had subjects recognize familiar tunes which were transformed in various ways. It was suggested that subjects do retain information about absolute intervals as well as contour and pitch in long-term musical memory. These studies helped formulate the idea for linking familiar tunes to intervals in the story narrative treatment. Finally, the decision to use tape recorders and earphones for treatment and testing was partially based on the research examining hemispheric dominance for music. It was concluded that at the present there is no evidence to justify the view that either the right or the left hemisphere alone exhibits an unequivocal cerebral specialization for the components of musical cognition. Therefore, there was no need to control for which ear received the auditory stimuli.

CHAPTER III

METHOD AND PROCEDURE

Subjects

The subjects consisted of a total of 406 third, fourth, fifth, and sixth grade students attending four elementary schools in one community in Northeastern Oklahoma. Stratified random sampling was used to account for gender and grade level. Subjects were first separated in each classroom at each grade level by gender and then randomly assigned to one of two interval learning methods: rote or story narrative. Since the analysis of variance used in this study required an equal number of subjects in each cell, two solutions were employed: discarding scores and estimating missing scores (Linton and Gallo, 1975). This process resulted in a total of 400 scores or subjects represented.

Instrument

The instrument used in this study was designed by the experimenter. Seven intervals were chosen for testing because of the sequential introduction used in Richard's (1964) "Threshold to Music." This method and the story narrative both start with a minor third and follow the same sequence of interval presentation. The seven intervals also form a major ascending scale, excluding a major seventh, which children can readily identify. There are many familiar songs for children that begin with these intervals. Familiar songs with beginning intervals for those not included are difficult to find.

Three chances were given to select each interval with two chances given to select the perfect eighth. This made a total of 20 responses and a possible range of scores from 0 to 20. The piano was used to produce the intervals, which were recorded on tape for the two experimental methods. The subjects recorded their answers on two response sheets. A worksheet was provided for the learning session and an interval review sheet for the testing sessions. A total of 30 minutes was required for completing the two sessions.

The purpose of the instrument was to test the recognition, identification, and recall of seven intervals learned through two methods of instruction. The test is valid to the extent that it measures only those intervals involved in both the rote and story narrative learning sessions. Since content validity requires both face validity and sampling validity, the latter is met by the equal number of chances given to select each interval. Rationale equivalence reliability of the test was determined through application of the Kuder-Richardson formula generally referred to as the K-R 20 (Gay, 1976). This reliability is established by determining how each item on a test relates to all other items on the test and to the total test (Gay, 1976). Using the formula K-R 20, the reliability coefficient obtained was .28. Table I summarizes the results (number correct) of each test item by grade level. This relatively low value may be due to a variety of factors such as the conditions of administration and status of the subjects taking the test.

TABLE I

FREQUENCY OF CORRECT TEST ITEM RESPONSES*

Question Item	Interval**	Letter Choice	3rd Gr	4th Gr	5th Gr	6th Gr	Totals
1	Mi3	A	3	16	23	18	60
2	P5	D	12	28	19	29	88
3	M6	E	14	16	16	13	59
4	M2	G	20	17	11	2	50
5	P8	F	15	14	19	20	68
6	P4	C	12	18	18	11	59
7	M3	B	20	20	16	20	76
8	P8	F	12	10	22	23	67
9	Mi3	A	19	14	14	16	63
10	P5	D	16	25	24	25	90
11	M6	E	5	21	18	24	68
12	M2	G	5	18	9	8	40
13	P4	C	12	16	18	30	76
14	M3	B	9	16	24	14	63
15	Mi3	A	6	18	16	12	52
16	P5	D	10	15	19	14	58
17	M6	E	11	12	21	16	60
18	M2	G	17	9	14	10	50
19	P4	C	21	16	23	16	76
20	M3	B	16	16	13	14	59
Totals			255	335	357	335	1,282
Number of Subjects			84	114	109	99	406
Possible Correct Responses							8,120

*See alternative frequency form B and K-R 20 Formula in Appendix C.

**Mi = minor; M = major; and P = perfect.

Design

The design used in this study was the posttest-only control group design. (See Figure 2.) This design was selected because of the controls that it provides for sources of invalidity. The combination of random assignment and presence of a control group serve to control for all sources of external and internal invalidity except mortality which does not apply in this study. This design accommodated the size of the sample and difficulty of scheduling the test.

Procedure

After the subjects were selected and assigned to the two learning methods, they listened to the two method tapes through earphones. Earphones were used so that both methods could be taught and tested in the same room at the same time. There were six earphones attached to a tape recorder adapter plugged into a tape recorder. This equipment was obtained from the Miami School System. There were six tape recorders and six adapter sets available. The subjects sat at desks pushed together. They recorded their responses on the "worksheet" and "review (test) sheet." The children were told the purpose of the study after the testing.

Two teachers monitored the use of the earphones and tapes. These teachers were selected to negate tester bias. The only instruction given by the teacher was to write the needed information before the tape was started. The teachers were responsible for the working condition of the equipment plus starting, stopping, and rewinding of the tapes.

R Random Assignment	X Independent Variable	0 Dependent Variables Posttest
200 subjects to experimental group	Story Narrative	Test Scores

400 Subjects

R Random Assignment	Independent Variable	0 Dependent Variables Posttest
200 subjects to control group	Rote	Test Scores

Figure 2. Posttest-Only Control Group Design

Variables

Independent: Interval learning-retention method.

1. Method

   A. Rote
   B. Story Narrative

2. Gender

3. Grade level (3, 4, 5, 6)

Dependent: Scores (correct responses) obtained from interval test.

Hypotheses

The following seven hypotheses are stated in the null and alternative forms:

1)H_0: There is no difference in accuracy of interval recognition, identification, and recall between students who receive the story narrative treatment and students who receive the traditional (rote) treatment.

H_1: There is a difference in accuracy of interval recognition, identification, and recall between students who receive the story narrative treatment and students who receive the traditional (rote) treatment.

2)H_0: There is no difference in accuracy of interval recognition, identification, and recall between sexes.

H_1: There is a difference in accuracy of interval recognition, identification, and recall between sexes.

3)H_0: There is no difference in accuracy of interval recognition, identification, and recall among grade levels (3, 4, 5, 6).

H_1: There is a difference in accuracy of interval recognition, identification, and recall among grade levels (3, 4, 5, 6).

4)H_0: There are no interactions between gender and method that affect the accuracy of interval recognition, identification, and recall.

H_1: There are interactions between gender and method that affect the accuracy of interval recognition, identification, and recall.

5)H_0: There are no interactions between gender and grade level that affect the accuracy of interval recognition, identification, and recall.

H_1: There are interactions between gender and grade level that affect the accuracy of interval recognition, identification, and recall.

6)H_0: There are no interactions between method and grade level that affect the accuracy of interval recognition, identification, and recall.

H_1: There are interactions between method and grade level that affect the accuracy of interval recognition, identification, and recall.

7)H_0: There are no interactions between all three factors of method, gender, and grade level that affect the accuracy of interval recognition, identification, and recall.

H_1: There are interactions between all three factors of method, gender, and grade level that affect the accuracy of interval recognition, identification, and recall.

Statistical Analysis

The research design was a 2x2x4 between-subjects factorial (ANOVA) representing learning-retention methods, gender, and grade levels. All a posteriori comparisons among means were to be made with Tukey's A ratio (Huck, Cormier, and Bounds, 1974; Linton and Gallo, 1975). A minimum significance level of .05 was selected for F ratios.

CHAPTER IV

ANALYSIS AND TREATMENT OF DATA

Introduction

The purpose of this study was to examine the differences in memory response resulting from two learning-retention instructional methods. The dependent variable was the scores (correct responses) obtained from the interval test. The independent variables were method (story and rote), gender, and grade level (3, 4, 5, 6). The control or nonmanipulated variables were gender and grade level. Analysis of variance (2x2x4) between subjects was performed on the three independent variables with .05 selected for significance.

Group Comparability

Means and standard deviations for each of the 16 analysis of variance cells are presented in Table II. Table III shows the means and standard deviations for the three main effects of method, gender, and grade level. The range of scores was 0-13. Table IV and Figure 3 represent a positive skewness of these scores. It is speculated that the skewness correlates with the low reliability of the test.

Tests of the Hypotheses

Each of the seven null and alternative hypotheses will be discussed

TABLE II

MEANS AND STANDARD DEVIATIONS FOR ANOVA CELLS

Grade Level	Gender	Story Narrative $\bar{X}$	Story Narrative SD	Rote $\bar{X}$	Rote SD
3	Girl	3.25	1.46	3.11	1.35
	Boy	3.16	1.71	2.82	1.38
4	Girl	2.86	1.58	3.00	1.36
	Boy	3.40	2.00	2.80	2.00
5	Girl	3.56	2.76	3.35	1.92
	Boy	2.84	1.16	3.28	3.00
6	Girl	3.43	1.66	3.44	1.81
	Boy	3.21	1.79	3.28	1.18

Note: n = 25 for each cell.

TABLE III

MEANS AND STANDARD DEVIATIONS FOR THE THREE MAIN EFFECTS OF METHOD, GENDER, AND GRADE EFFECT

	$\bar{X}$	SD
Story	3.21	1.83
Rote	3.14	1.85
Girls	3.25	1.81
Boys	3.10	1.88
Grade 3	3.08	1.49
Grade 4	3.02	1.77
Grade 5	3.25	2.34
Grade 6	3.34	1.64

Note: n = 200 for Method and Gender; n = 100 for Grade Level.

TABLE IV

RANGES AND ITEMIZED FREQUENCY OF SCORES

Score Range	3rd G/S	3rd B/S	3rd G/R	3rd B/R	4th G/S	4th B/S	4th G/R	4th B/R	5th G/S	5th B/S	5th G/R	5th B/R	6th G/S	6th B/S	6th G/R	6th B/R	Totals
0	1	1	1	2	1	3		4	1			2	1		2		19
1	1		2		4	2	4	3	5	3	3	5	2	5		1	40
2	4	10	3	11	8	2	5	6	4	6	5	4	3	5	4	7	87
3	14	8	12	6	5	6	6	2	5	11	10	7	11	6	9	6	124
4		1	4	4	4	5	9	5	3	3	4	3	2	3	4	6	60
5	3	1	1		1	3		2	3	1			2	3	4	5	29
6	1	2	2	2	1	2		2	1	1	1	2	3	1	1		22
7	1	2			1	2	1	1	1		1		1	2			13
8									1								1
9															1		1
10											1						1
11												1					1
12																	0
13									1			1					2
																	400

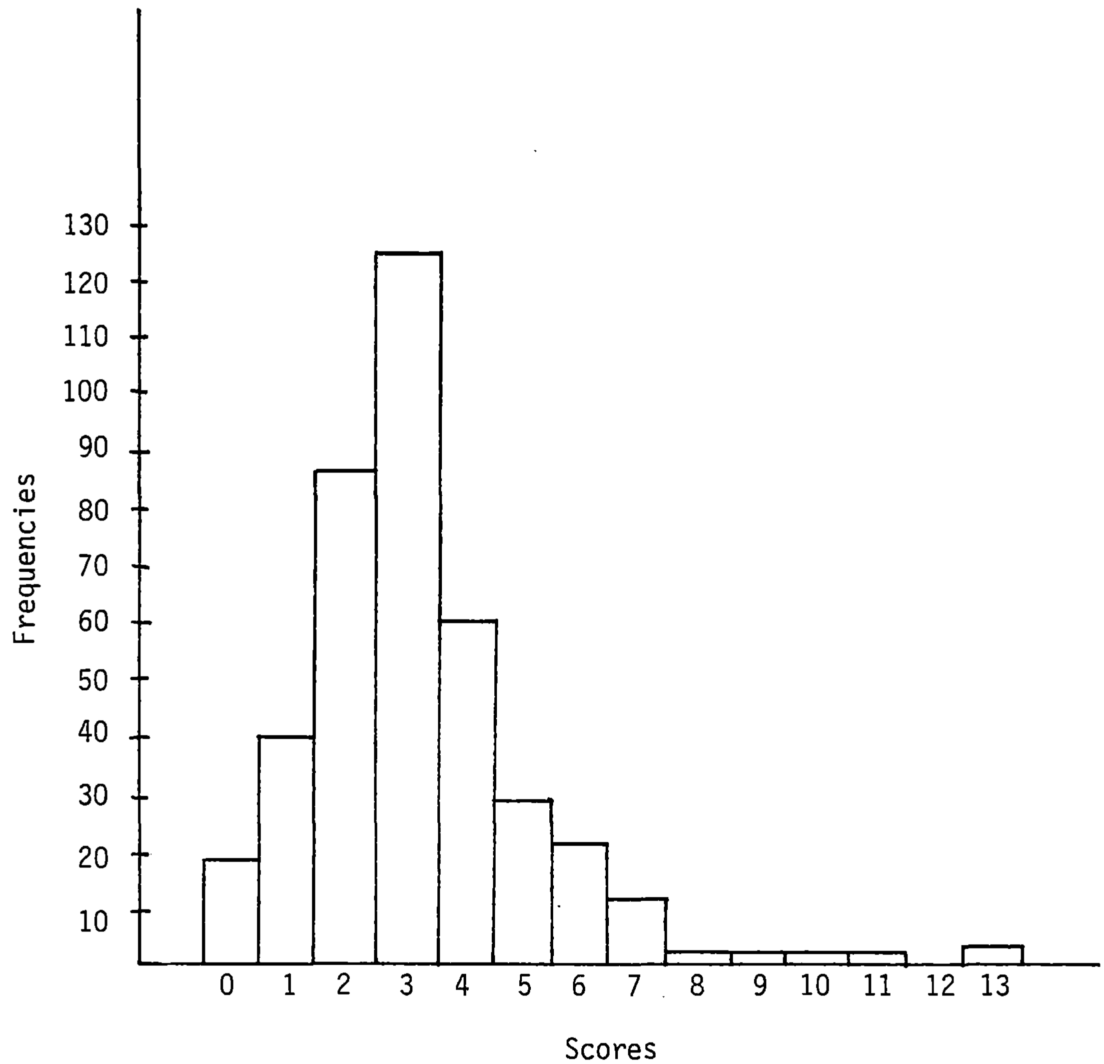


Figure 3. Frequency of Scores

in terms of the statistical results obtained from the analysis of variance.

The first hypothesis in null form stated: There is no difference in accuracy of interval recognition, identification, and recall between students who receive the story narrative treatment and students who receive the traditional (rote) treatment. The summary of the three way analysis of variance for the two learning-retention methods on interval accuracy response is located in Table V. The results indicate that there is not a significant difference in accuracy of interval recognition, identification, and recall between students who received the story narrative treatment and students who received the traditional (rote) treatment ($F_{1,384} = .18$, $p = .05$; $F > 3.84$ for significance). Therefore, the first null hypothesis was not rejected.

The second null hypothesis stated: There is no difference in accuracy of interval recognition, identification, and recall between sexes. The results indicate that there is not a significant difference between male and female students in accuracy of interval recognition, identification, and recall ($F_{1,384} = .66$, $p = .05$; $F > 3.84$ for significance); therefore the second null hypothesis was not rejected.

The third null hypothesis reads: There is no difference in accuracy of interval recognition, identification, and recall between grade levels. The results indicate no significant differences between grade levels in accuracy of interval recognition, identification, and recall ($F_{3,384} = .64$, $p = .05$; $F > 2.60$ for significance); therefore, the third null hypothesis was not rejected.

The fourth null hypothesis stated: There are no interactions between gender and method that effect the accuracy of interval

TABLE V

ANOVA SUMMARY

	df	SS	MS	F
Gender (A)	1	2.31	2.31	.66
Method (B)	1	.63	.63	.18
Grade Level (C)	3	6.72	2.24	.64
A x B	1	.08	.08	.02
A x C	3	6.31	2.10	.60
B x C	3	2.55	.85	.24
A x B x C	3	4.03	1.34	.39
Error	384	1335.45	3.48	

Note: All $p > .05$.

recognition, identification, and recall. No significant interaction effect was obtained between gender and method of learning-retention ($F_{1,384}$ = .02, p = .05; F > 3.84 for significance); therefore, the fourth null hypothesis was not rejected.

The fifth null hypothesis proposed: There are no interactions between gender and grade level that effect the accuracy of interval recognition, identification, and recall. No significant interaction effect was obtained between gender and grade level ($F_{3,384}$ = .60, p = .05; F > 2.60 for significance); therefore, the fifth null hypothesis was not rejected.

The sixth null hypothesis reads: There are no interactions between method and grade level that effect the accuracy of interval recognition, identification, and recall. No significant interaction effect was obtained between method and grade level ($F_{3,384}$ = .24, p. = .05; F > 2.60 for significance); therefore, the sixth null hypothesis was not rejected.

The seventh and last null hypothesis proposed: There are no interactions between all three factors of method, gender, and grade level that effect the accuracy of interval recognition, identification, and recall. No significant interaction effect was obtained from the three factors ($F_{3,384}$ = .39, p = .05; F > 2.60 for significance); therefore, the seventh null hypothesis was not rejected.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary of the Investigation

This study examined the accuracy of interval recognition, identification, and recall resulting from two learning-retention methods. The subject population included a total of 406 third, fourth, fifth, and sixth grade students attending four elementary schools in one community in Northeastern Oklahoma. Stratified random sampling was achieved in each classroom by gender. Subjects were randomly assigned to one of the two interval learning-retention methods, rote or story narrative. The story narrative used association of musical syllables with familiar song titles woven into a story for interval recognition, identification, and recall. In the rote method no associations were suggested. Students in the rote treatment were to listen to the sound several times for the purpose of recognition, identification, and recall.

Subjects listened through earphones to the two types of instruction recorded on tape. By this means both the experimental and control groups could be tested in the same room at the same time. Tapes were also used to negate tester bias and allow for a more flexible time schedule. Subjects recorded their responses on two different response sheets, one for training and the other for testing.

The results of the study were subjected to three-way between subjects analysis of variance with all significant differences to be tested with Tukey's ratio. The results of the investigation indicated no significant difference between the two methods and no significant differences between gender or grade level. No significant interactions occurred among the three variables. Since there were no significant differences, Tukey's "A" procedure was not used.

Conclusions of the Study

Several possible explanations might be given for the lack of significant results. First, the experimental procedure was no more effective than the rote procedure. Second, the climate for testing in the community was negative at the time arrangements were being made. There was to be a change in administration and board members. Morale among teachers was at a low ebb resulting in a lack of cooperation among all parties concerned. A proposed bond issue failed to pass causing much friction in the community. Therefore, getting permission to test did not occur at a favorable time. Also, the testing was scheduled near the end of the school year. It was with great difficulty that scheduling for such a large group of subjects was achieved. It could not have been accomplished without the aid of two associate teachers who, with instruction, assigned the subjects, scheduled the testing, and set up the equipment. Under these conditions pre and posttesting was not possible. Most of the studies cited in the literature show that the effectiveness of the story narrative does not show up on immediate recall. Therefore, this could be conjectured as a reason for insignificant results.

Third, students did not realize or chose not to recognize the serious nature of the testing situation. It was reported that the behavior of some would effect the results. Sixth grade students seemed to display the most negative behavior but the statistics did not indicate this influence on the results as compared to the other grades. From the review of the literature, most experiments were conducted with adults or college age subjects. Only one study involving children was found. It used 24 kindergartners (Gallimore et al., 1977).

Fourth, the length of the tape and number of intervals introduced in one session might have decreased the accuracy of responses. From experience, the story narrative has been taught in five sessions with testing and review in each session. Also, the impersonal nature of listening to a tape might have influenced such learning factors as attention, interest, and visual imagery. Further evidence in this area needs to be secured. The use of visual imagery with the interval story narrative might help the students relate to the characters involved. Talking about feelings and anticipating possible alternatives could focus attention on the sequence of the story.

Recommendations

Since the results of this study were not statistically significant, implications for educational practice are speculative. Further research is needed to determine whether there is a difference in accuracy of interval recognition, identification, and recall between students who receive the story narrative treatment and students who receive the traditional rote treatment. One speculation might involve the application of the story narrative to reading musical notes. There are several processes involved in reading music. First, the student should be able to tell whether two intervals are the same or different when heard. They should be able to recognize repeated intervals from a series of intervals. Second, the width or size of the interval should be determined. This is essential for reproducing music on an instrument (keyboard) and for writing or recording musical intervals. Both of these processes involve the sense of hearing but the third process is a visual one. From looking at an interval on the staff, the student should know what it sounds like and be able to reproduce it vocally or on an instrument. The writer has found this to be a weak skill area in elementary music education programs. Searching for a solution to this problem led to the development of the interval story narrative instructional method. From the story narrative, students can identify three bits of information: (1) who is talking, (2) the distance of the interval or how many steps, and (3) the song title or what they (syllables) are saying. Looking at the written interval, the student can first count the number of lines and spaces or stair steps. This is then related to the story syllables and "who is talking." The last association can then be made which is the song title. Names of notes do not have to be taught before playing a keyboard instrument or reproducing written music because a song can be played by counting the number of steps in an interval and then counting the number of keys. The story narrative offers an alternative way to teach note relationships from the more common method of learning the location, fingerings, and names of specific notes.

Researchers, from studies cited previously, have suggested that if a mnemonic is going to benefit retention, it will do so over a long period of time, not just immediately (Boltwood and Blick, 1970; Gallimore et al., 1977). This suggestion should be considered for improvements in this study and future versions of it. Other recommendations suggested by the research cited might be as follows:

1. Future research needs to consider the pacing and sequencing of musical intervals and instruction.

2. Older or adult subjects might be used to allow for greater errors of measurement due to developmental differences and status of persons taking the test.

3. Fewer subjects would make scheduling much easier and enable repetitive sessions.

4. The nature of information to be learned might be a factor in the determination of the effectiveness of mnemonic strategy.

5. Concrete versus abstract words, high imagery versus low imagery words, and imagery interaction in the story narrative could be investigated.

6. The associations of intervals with certain song titles might be re-examined.

7. Development and/or use of measuring instruments with greater reliability and validity should be addressed in future research.

Using the Jeffries (1967) study as a model, future designs might be implemented in the following way. A screening device such as the SING battery might be used to obtain subjects of matched musical capacity. It would also be required that subjects not have previous learned experience in naming intervals by note or designation. The training period could be set up in a predetermined number of sessions, each lasting 15-20 minutes. These sessions could occur on a daily basis in the regular classroom setting, which might eliminate some of the negative attitudes students have concerning the testing situation. Session one for the rote and story methods would consist of an introduction and drill for one or two intervals. The story method would introduce the interval by means of the story, relating the sound to syllables and song title. The rote method would identify the interval by sounding it and then offer a designated number of times, perhaps three, to hear the interval. A random presentation of intervals would then be given providing an opportunity to identify the intervals introduced in this session.

The sequence of intervals for session two and the remaining sessions might be:

1. Drill (rote method) or review (story) of intervals introduced in session one.

2. Introduction and drill of new interval. This would differ for story and rote.

3. Introduction and drill of second new interval.

4. Random presentation of intervals introduced so far in training.

Upon completion of instruction and training, each subject would be given a posttest, a transfer test, and retention test covering the interval material taught during training. The posttest would be given the school day following completion of training, the transfer test the next day, and a retention test two weeks later.

A SELECTED BIBLIOGRAPHY

Anderson, R. C., and Hidde, J. L. Imagery and sentence learning. Journal of Educational Psychology, 1971, 62, 526-530.

Attneave, F., and Olsen, R. K. Pitch as a medium: A new approach to psycho-physical scaling. American Journal of Psychology, 1971, 84, 147-165.

Baddeley, A. D. The Psychology of Memory. New York: Basic Books, Inc., Publishers, 1976.

Baddeley, A. D., and Patterson, K. The relationship between long-term and short-term memory. British Medical Bulletin, 1971, 27, 237-242.

Bartlett, J. C., and Dowling, W. J. The recognition of transposed melodies: A key-distance effect in developmental perspective. Journal of Experimental Psychology: Human Perception and Performance, 1980, 6, 501-515.

Bartz, A. E. Basic Statistical Concepts in Education and the Behavioral Sciences. Moorhead, Minnesota: Burgess Publishing Co., 1976.

Bever, T. G., and Chiarello, R. J. Cerebral dominance in musicians and non-musicians. Science, 1974, 185, 137-139.

Biehler, R. F., and Snowman, J. Psychology Applied to Teaching. Boston: Houghton Mifflin, 1982.

Bjork, R. A. Information-processing analysis of college teaching. Educational Psychologist, 1979, 14, 15-23.

Boltwood, C. E., and Blick, K. A. The delineation and application of three mnemonic techniques. Psychonomic Science, 1970, 20, 339-341.

Bousfield, W. A. The occurrence of clustering in the recall of randomly arranged associates. Journal of General Psychology, 1953, 49, 229-240.

Bower, G. H. Educational applications of mnemonic devices. In K. O. Doyle (ed.), Interaction: Readings in Human Psychology. Lexington, Mass.: D. C. Heath, 1973a.

________. How to ... uh ... remember. Psychology Today, 1973b, 7(5), 63-70.

Bower, G. H., and Clark, M. C. Narrative stories as mediators for serial learning. Psychonomic Science, 1969, 36, 181-182.

Bower, G. H., and Winzenz, D. Comparison of associative learning strategies. Psychonomic Science, 1970, 20, 119-120.

Brown, A. L., and Smiley, S. S. Rating the importance of structural units of prose passages: A problem of metacognitive development. Child Development, 1977, 48, 1-8.

Cermak, L. S. Human Memory: Research and Theory. New York: Ronald Press, 1972.

Chalfant, J., and Scheffelin, M. Central Processing Dysfunction in Children. NINDS Monograph No. 9. Bethesda, MD: Department of Health, Education, and Welfare, 1969.

Chang, H. W., and Trehub, S. Auditory processing of relational information by young infants. Journal of Experimental Child Psychology, 1977a, 24, 324-331.

_________. Infants' perception of temporal grouping in auditory patterns. Child Development, 1977b, 48, 1666-1670.

Cohen, B. H., Bousfield, W. A., and Whitmarsh, G. A. Cultural norms for verbal items in 43 categories. Technical Report No. 22. University of Connecticut, 1957.

DeRenzi, E. Nonverbal memory and hemispheric side of lesion. Neuropsychologia, 1968, 6, 181-189.

Deutsch, D. Music recognition. Psychological Review, 1969, 76, 300-307.

_________. Tones and numbers: Specificity of interference in short-term memory. Science, 1970, 168, 1604-1605.

_________. Facilitation by repetition in recognition memory for tonal pitch. Memory and Cognition, 1975, 3, 263-266.

_________. Memory and attention in music. In M. Critchley and R. A. Henson (eds.), Music and the Brain. London: William Heinemann Medical Books Limited, 1977.

_________. Interactive effects in memory for harmonic intervals. Perception and Psychophysics, 1978, 24, 7-10.

Dowling, W. J. Scale and contour: Two components of a theory of memory for melodies. Psychological Review, 1978, 85, 341-354.

_________. Melodic information processing and its development. In D. Deutsch (ed.), The Psychology of Music. New York: Academic Press, Inc., 1982.

Dowling, W. J., and Fujitani, D. S. Contour, interval, and pitch recognition in memory for melodies. Journal of the Acoustical Society of America, 1971, 49, 524-531.

Ebbinghaus, H. Uber das gedachtnis. In A. D. Baddeley (ed.), The Psychology of Memory. New York: Basic Books, Inc., Publishers, 1976.

Flavell, J. H. First discussant's comments: What is memory development the development of? Human Development, 1971, 14, 272-278.

Flavell, J. H., and Wellman, H. M. Metamemory. In R. V. Kail, Jr., and J. W. Hagen (eds.), Perspectives on the Development of Memory and Cognition. Hillsdale, New Jersey: Erlbaum Associates, Inc., 1977.

Fry, D. B. Reaction-Time Experiments in the Study of Speech Processing. Academia Publishing House of the Czechoslovak Academy of Sciences, 1970.

Gallimore, R., Lam, D. J., Speidel, G. E., and Tharp, R. G. The effects of elaboration and rehearsal on long-term retention of shape names by kindergartners. American Educational Research Journal, 1977, 14, 471-483.

Gay, L. R. Educational Research: Competencies for Analysis and Application. Columbus, Ohio: Charles E. Merrill Publishing Co., 1976.

Gazzaniga, M. S., and Sperry, R. W. Language after section of the cerebral commissures. Brain, 1967, 90, 131-148.

Gordon, H. W. Hemispheric asymmetries in the perception of musical chords. Cortex, 1970, 6, 387-398.

Gordon, H. W., and Bogen, J. E. Hemispheric lateralization of singing after intracarotid sodium amylobarbitone. Journal of Neurosurgical Psychiatry, 1974, 37, 727-738.

Hagen, J. W., and Stanovich, K. G. Memory: Strategies of acquisition. In R. V. Kail and J. W. Hagen (eds.), Perspectives on the Development of Memory and Cognition. Hillsdale, New Jersey: Erlbaum Associates, 1977.

Halperin, Y., Nachshon, I., and Carmon, A. Shift of ear superiority in dichotic listening to temporal patterned non-verbal stimuli. Journal of Acoustics Society of America, 1973, 53, 46-50.

Harris, P. L. Developmental aspects of children's memory. In M. M. Greenberg, P. E. Morris, and R. N. Sykes (eds.), Practical Aspects of Memory. New York: Academic Press, 1978.

Haydon, S. P., and Spellacy, F. J. Monoaural reaction time asymmetries for speech and nonspeech sounds. Cortex, 1973, 9, 288-294.

Henson, R. A. Neurological aspects of musical experience. In M. Critchley and R. A. Henson (eds.), Music and the Brain. London: William Heinemann Medical Books Limited, 1977.

Higbee, K. L. Your Memory: How It Works and How to Improve It. Englewood Cliffs, New Jersey: Prentice-Hall, 1977.

__________. Recent research on visual mnemonics: Historical roots and educational fruits. Review of Educational Research, 1979, 49(4), 611-629.

Holmes, P. M., and Murray, D. J. Free recall of sentences as a function of imagery and predictability. Journal of Experimental Psychology, 1974, 102, 748-750.

Howe, M. J. A., and Ceci, S. J. Educational implications of memory research. In M. M. Gruneberg and P. E. Morris (eds.), Applied Problems in Memory. New York: Academic Press, 1979.

Huck, S. W., Cormier, W. H., and Bounds, W. G. Reading Statistics and Research. New York: Harper and Row, 1974.

Hudson, R. L. Category clustering for immediate and delayed recall as a function of recall cue information and response dominance variability. Journal of Experimental Psychology, 1969, 82, 575-577.

Imberty, M. L'acquisition des structures tonales chez l'enfant. Paris: Klincksieck, 1969.

Jeffries, T. B. The effects of order of presentation and knowledge of results on the aural recognition of melodic intervals. Journal of Research in Music Education, 1967, 15, 179-190.

__________. Familiarity-frequency ratings of melodic intervals. Journal Research in Music Education, 1972, 20, 391-396.

__________. Relationship of interval frequency count to ratings of melodic intervals. Journal of Experimental Psychology, 1974, 102(5), 903-905.

Jorm, A. F. Effect of word imagery on reading performance as a function of reader ability. Journal of Educational Psychology, 1977, 69, 46-54.

Kail, R. The Development of Memory in Children. San Francisco: Freeman, 1979.

Kail, R., and Hagen, J. W. Perspectives on the Development of Memory and Cognition. Hillsdale, New Jersey: Erlbaum Associates, Inc., 1977.

Kallman, H. J., and Corballis, M. C. Ear asymmetry in reaction time to musical sounds. Perceptions in Psychophysiology, 1975, 17, 368-370.

Kessen, W., Levine, J., and Wendrich, K. A. The imitation of pitch in infants. Infant Behavior and Development, 1979, 2, 93-99.

Kinney, D. K., and Kagan, J. Infant attention to auditory discrepancy. Child Development, 1976, 47, 155-164.

Kimura, D. Left-right differences in the perception of melodies. Quarterly Journal of Experimental Psychology, 1964, 16, 355-358.

Kirk, G. E. Experimental Design: Procedures for the Behavioral Sciences. Belmont, California: Brooks/Cole, 1968.

Kreutzer, M. A., Leonard, C., and Flavell, J. H. An interview study of children's knowledge about memory. Monograph Society of Research Child Development, 1975, 40 (1, Serial No. 159).

Lerner, J. Learning Disabilities: Theories, Diagnosis, and Teaching Strategies. Boston: Houghton Mifflin, 1981.

Levin, J. R. What have we learned about maximizing what children learn? In J. R. Levin and V. L. Allen (eds.), Cognitive Learning in Children: Theories and Strategies. New York: Academic Press, 1976.

Linton, M., and Gallo, P. S. The Practical Statistician. Monterey, California: Brooks/Cole, 1975.

Lloyd, L. S., and Boyle, H. Intervals, Scales and Temperaments. London: Macdonald, 1963.

Mackworth, N. H., and Bruner, J. S. How adults and children search and recognize pictures. Human Development, 1970, 13, 149-177.

Manning, B. A., and Bruning, R. H. Interactive effects of mnemonic techniques and word-list characteristics. Psychological Reports, 1975, 36, 727-736.

Marks, M. R., and Miller, G. A. The role of semantic and syntactic constraints in the memorization of English sentences. Journal of Verbal Learning and Verbal Behavior, 1964, 3, 1-5.

McKee, G., Humphrey, B., and McAdam, D. W. Scaled lateralization of alpha activity during linguistic and musical tasks. Psychophysiology, 1973, 10, 441-443.

Melson, W. H., and McCall, R. B. Attentional responses of five-month girls to discrepant auditory stimuli. Child Development, 1970, 41, 1159-1171.

Michael, L. D., King, J. W., and Moorhead, A. MKM Reading Systems. Rapid City, SD: MKM Inc., 1978.

Morris, P. E. Strategies for learning and recall. In M. M. Gruneberg and P. E. Morris (eds.), Applied Problems in Memory. New York: Academic Press, 1979.

Morrison, F. J., Giordani, B., and Nagy, J. Reading disability: An information processing analysis. Science, 1977, 196, 77-79.

Murray, F. S. Effects of narrative stories on recall. Bulletin of the Psychonomic Society, 1974, 4(6), 577-579.

Myers, J. L., Pezdek, K., and Coulson, D. Effects of prose organization upon free recall. Journal of Educational Psychology, 1973, 65(3), 313-320.

Nachshon, L. Effects of cerebral dominance and attention on dichotic listening. T.I.T.J. Life Sciences, 1973, 3, 107-114.

Neisser, U. Cognition and Reality. San Francisco: Freeman, 1976.

Ostwald, P. F. Musical behavior in early childhood. Developmental Medicine and Child Neurology, 1973, 73, 367-375.

Paivio, A. Imagery and Verbal Processes. New York: Holt, Rinehart, and Winston, 1971.

Paris, S. G., and Lindauer, B. K. Constructive aspects of children's comprehension and memory. In R. V. Kail and J. W. Hagen (eds.), Perspectives on the Development of Memory and Cognition. Hillsdale, New Jersey: Erlbaum Associates, 1977.

Paris, S. G., and Upton, L. R. Children's memory for inferential relationships in prose. Child Development, 1976, 47, 660-668.

Plomp, R., Wagenaar, W. A., and Mimpen, A. M. Musical interval recognition with simultaneous tones. Acustica, 1973, 29, 101-109.

Prytulak, L. S. Natural language mediation. Cognitive Psychology, 1971, 2, 1-56.

Revesz, G. Introduction to the Psychology of Music. Norman, Oklahoma: University of Oklahoma Press, 1964.

Richards, M. H. Threshold to Music, Based on the Educational Philosophy of Zoltan Kodaly. New York: Harper and Row Publishers, 1964.

Richardson, J. T. E. Mental Imagery and Human Memory. New York: St. Martin's Press, 1980.

Robinson, G., and Solomon, D. J. Rhythm is processed by the speech hemisphere. Journal of Experimental Psychology, 1974, 102, 508-511.

Rust, S. M., and Blick, K. A. The application of two mnemonic techniques following rote memorization of a free-recall task. Journal of Psychology, 1972, 80, 247-253.

Senter, R. J., and Hoffman, R. R. Bizarreness as a nonessential variable in mnemonic imagery: A confirmation. Bulletin of the Psychonomic Society, 1976, 7, 163-164.

Shuter, R. The Psychology of Musical Ability. London: Methuen, 1968.

Spellacy, F. Lateral preferences in the identification of pattern stimuli. Journal of Acoustic Society of America, 1970, 47, 574-578.

Springer, S. P., and Deutsch, G. Left Brain, Right Brain. San Francisco: Freeman, 1981.

Spreen, O., Spellacy, F. J., and Reid, J. R. The effect of interstimulus interval and intensity on ear asymmetry for non-verbal stimuli in dichotic listening. Neuropsychologia, 1970, 8, 245-250.

Thorndike, E. L., and Lorge, I. The Teacher's Book of 30,000 Words. New York: Bureau of Publications, Teachers College, Columbia University, 1944.

Torgesen, J. K. Memorization processes in reading-disabled children. Journal of Educational Psychology, 1977, 69, 571-578.

Tulving, E. Episodic and semantic memory. In E. Tulving and W. Donaldson (eds.), Organization of Memory. New York: Academic Press, 1972.

Tulving, E., and Osler, S. Effectiveness of retrieval cues in memory for words. Journal of Experimental Psychology, 1968, 77, 593-601.

Vergason, G. A. Facilitation of memory in the retardate. Exceptional Children, 1968, 34, 589-594.

Wendon, L. The Pictogram System. Cambridge: Barton, 1972.

White, B. Recognition of distorted melodies. American Journal of Psychology, 1960, 73, 100-107.

Wingfield, A., and Byrnes, D. L. The Psychology of Human Memory. New York: Academic Press, 1981.

Wiseman, D. E. A classroom procedure for identifying and remediating language problems. Mental Retardation, 1965, 3, 20-34.

Wittrock, M. C. The generative processes of memory. UCLA Educator, 1975, 17, 33-43.

Wittrock, M. C., and others. The Human Brain. Englewood Cliffs, New Jersey: Prentice-Hall, 1977.

Wyke, M. A. Musical ability: A neuropsychological interpretation. In M. Critchley and R. A. Henson (eds.), Music and the Brain. London: William Heinemann Medical Books Limited, 1977.

Zaidel, D., and Sperry, R. W. Memory impairment after commissurotomy in man. Brain, 1974, 97, 263-272.

Zechmeister, E. B., and Nyberg, S. E. Human Memory: An Introduction to Research and Theory. Monterey, California: Brooks/Cole, 1982.

APPENDICES

APPENDIX A

STORY NARRATIVE AND ROTE INSTRUCTION

SCRIPTS AND TEST FORMS

STORY NARRATIVE AND ROTE INSTRUCTION

SCRIPTS AND TEST FORMS

The notes of a major scale can be labeled using syllables, numbers, or letters. These notes are arranged on five lines and four spaces called a STAFF. You can think of the staff as stair steps for the notes to climb up, down, or skip. (Refer to your worksheet to see an example of notes using syllables and numbers.) Do can be found by this sign (key). Each line and each space is a step. Do is always the first note of the scale, followed by re(2), mi(3), fa(4), sol(5), la(6), and ti(7). Do can start on any line or space. (See example #1.) Seven letters, ABCDEFG, are used to label all the 88 keys on the piano. For the purpose of the following lessons only syllables will be used.

Measuring the distance of sound (pitch) up or down from one note to the next is called an INTERVAL. It takes two notes to make an interval. An interval is measured by counting the lines and spaces or steps. Certain distances have sound associations that remain the same regardless of the syllable or letter names. For example, (see worksheet #2), a fourth will have the same relational sound from Do to fa, re to sol, mi to la, or sol to high do, even though the syllables are different. All are four steps apart--count the lines and spaces. Consequently, if you identify the pitch relationship of a specific distance, you will be able to translate musical notes into sound for singing or playing instruments.

The above narration was the same for both experimental groups but the following continues for the STORY NARRATIVE group only.

Listen to the following story. Using the story you will be asked to identify specific intervals (the sound of certain distances).

Once upon a time all the notes of the scale moved into a musical apartment house with 5 floors and 4 doors. (See your worksheet #3.) Upon entering the front door there were eight stair steps to climb with a ninth step leading to the attic. All the notes used the stair steps for climbing, skipping, and lining up behind DO, their leader. In addition to being the leader, DO kept the key (see your worksheet), to the apartment house. This key symbol can be used to find DO. DO will be found on the same line or space as the key. Most of the notes in this musical family lived together harmoniously with the exception of SOL. SOL was a pest. He particularly liked to pester MI who lived below him. (Look at your worksheet #4. If SOL is on a space MI is on a space below him. If SOL is on a line then MI is on a line below him. They are 3 steps apart.) SOL would yell YOO HOO out his window every morning trying to awaken MI. This would anger MI who liked to sleep late. MI would yell back to SOL, "LULLABY, I'm trying to sleep. Don't bother me Mr. SOL." If SOL and MI are playing at the same time or simultaneously they should sound like they "go-together", not clashing or mysterious.

Listen to the following sets of intervals in Part I. There will be four intervals played labeled ABCD. The two notes of each interval will be played <u>separately</u> and then <u>together</u>. Circle the letter of the interval that is 3 steps apart and sounds like YOO HOO (down sol to mi) or LULLABY (up mi to sol) when played separately and a "go-together" sound when played at the same time.

You will have a practice try. Did you circle letter D?
Now listen to the intervals for Part I (A-P8, B-mi3, C-P5, D-M6).
You should have circled letter B.

Part II

When SOL continued to pester MI, MI complained to DO, their leader. (See worksheet, DO is on a line or space 3 steps below MI. SOL to MI is called a Minor third while MI to DO is called a Major third. Major and Minor have a slightly different sound.) MI told DO that he thought he had LOST HIS PARTNER because he told him to SKIP TO MY LOU. Since this did not stop SOL, MI related to DO that he told SOL to SHOO FLY, DON'T BOTHER ME. DO then told MI to quit complaining because they (do-mi-sol) needed to stick together like THREE LITTLE INDIANS. (See worksheet, Example 5, all three are on lines or spaces.) DO to MI when played at the same time should have a "go-together" sound.

Listen to the following sets of intervals in Part II. Circle the letter of the interval that is 3 steps apart and sounds like SHOO FLY or LOST MY PARTNER (down MI to DO) or THREE LITTLE INDIANS (up DO to MI).

(A-M3, B-P4, C-M2, D-P8) You should have circled letter A.

Part III

After DO talks to MI, he decides to have a talk with SOL (5 steps up from DO). (See worksheet, Example 5.) He tells SOL that he has had a conversation with MI and has suggested they need to stick together like THREE LITTLE INDIANS. DO suggests that they form a club for the purpose of working together--an astronomy club. Their club song will be TWINKLE TWINKLE LITTLE STAR. Their meeting time will be THE MORE WE GET TOGETHER, the better. SOL says he will not join the club unless they meet in DIXIELAND where he was born. When DO and SOL are played together they sound mysterious, oriental, or like an Indian chant.

Listen to the following sets of intervals.....

(A-M6, B-P5, C-mi3, D-P8) You should have circled letter B.

Part IV

In the meantime, MI decides to find a new friend. He chooses LA who lives above SOL and refuses to be "bossed around" or intimidated by SOL. If SOL is on a line LA is on the space above. If SOL is in a space then LA is on the next line above. (See your worksheet, Example 6.) MI's problem is trying to decide how to meet LA. He decides to tell LA, who is 4 steps above MI, a secret--that someone in the musical family is getting married HERE COMES THE BRIDE. LA informs MI that he already knows the secret and who it is--OLD MACDONALD. OLD MACDONALD has a new job WORKING ON THE RAILROAD. Played together MI and LA sound mysterious, oriental.

Listen.....

(A-P5, B-M3, C-P4, D-M2) You should have circled letter C.

Part V

All the notes decide to go to Old MacDonald's wedding but have a problem deciding how to get there. High do finally suggests to Low DO that they WAIT FOR THE WAGON--8 steps apart. (See worksheet, Example 7.) After they all climb in the wagon, DO looks at the invitation and map and tells High do, the driver, that they must head SOMEWHERE OVER THE RAINBOW. DO to do has a go-together sound.

Listen to the following.....

Part VI

Once they reach their destination, they find that they must wait for the bride to arrive from across the ocean. Low DO asks LA (six steps up, see worksheet Example 8) who it is that Old MacDonald is going to marry. Since LA knew that Old MacDonald was getting married, DO thought he might know the name of the new bride. LA relates that Old MacDonald is going to marry Bonnie, MY BONNIE LIES OVER THE OCEAN. He also relates that they first met on the TV network NBC. DO to LA has a go-together sound.

Listen to the following.....

Part VII

While waiting for Bonnie, High do suggests to TI (2 steps down) and the other notes that they DECK THE HALLS WITH BOUGHS OF HOLLY. This will be their present to the new couple. After working hard all day Low DO suggests to RE (2 steps up) that they all need to rest and have a SILENT NIGHT. The next morning High do is the first to see the boat arrive in port. He nudges TI, who falls out of bed and starts a chain reaction down the stair step bunk beds, and says, "Joy to the World, the Bride has Come." This clashing of seconds causes a goosebump sound or feeling.

The End

Listen to the following.....

Reviewing the sequence of the story you heard:
sol to mi, 5-3, and mi to sol
mi-Do, 3-1, DO-mi
DO-sol, 1-5, sol-DO
mi-la, 3-6, la-mi
do-DO, 8-1, DO-do
DO-la, 1-6
do-ti, 8-7

DO-re, 1-2
do-ti, 8-7

ROTE GROUP

Listen to the following sound (play). This is the sound of sol to mi or mi to sol. Listen again. Sol to mi is an interval of three steps. See your worksheet Example 3. Notice that the key shows the position of DO. Now see if you can identify an interval of a 3rd such as sol to mi from a set of intervals. There will be four intervals played ABCD. Circle the letter of the interval that sounds like sol-mi or mi-sol. Each interval will be played separately up or down and together.

Practice try.

Part II

Listen to the following sound (play). This is the sound of mi to Low DO. Mi to DO is also 3 steps apart just as sol to mi but there is a slight difference in sound. See your worksheet Example 4. Listen and compare this difference sol to mi and mi to DO. Sol to mi is called a minor 3rd. Mi to DO is called a Major 3rd. Listen again to a Major 3rd. Now see if you can identify a Major 3rd or mi to DO. There will be four intervals played ABCD. Circle the letter of the interval that sounds like mi-DO or a Major 3rd. Each interval will be played separately up or down, and together.

Part III

Same-----This is the sound DO-sol. See your worksheet Example 5. Count the lines and spaces. There should be 5 steps from DO to sol. Listen again to this sound. Now see if you can identify an interval of a fifth played separately, and then together.

Part IV

Same-----This is the sound mi-la. See Example 6 on your worksheet. There are 4 steps from mi-la, la-mi. Listen again. Now see if you can identify an interval of a 4th played separately, then together.

Part V

Same-----This is the sound of Low DO to high do. See your worksheet Example 7. There are 8 steps from Low DO to high do. Listen again to this sound. Now see if you can identify an interval of an 8th played separately, then together.

Part VI

Same-----This is the sound of Low DO to la. There are 6 steps from Low DO to la. See your worksheet Example 8. Listen again to this sound and see if you can identify an interval of a sixth played separately, then together.

Part VII

Same-----This is the sound of Low DO to re or high do to ti. A line to the next space or space to the next line is called a Major second. Listen again to this sound and see if you can identify an interval of a second, Do to re or do to it, from a set of intervals. There will be four intervals played ABCD. Circle the letter of the interval that sounds like a Major second. Each interval will be played separately up or down, and together.

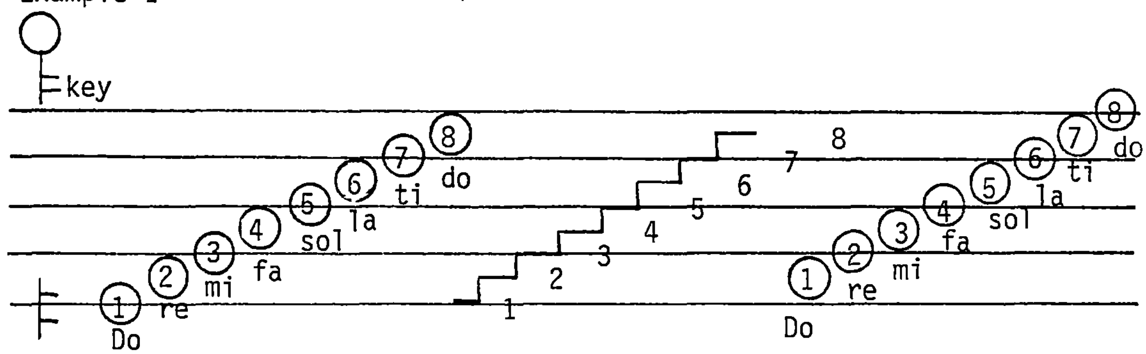
You have just heard the following intervals in this order.

sol to mi, 5-3
mi-DO, 3-1
DO-sol, 1-5
mi-la, 3-6
DO-do,1-8
DO-la, 1-6
DO-re or do-ti, 1-2 or 8-7

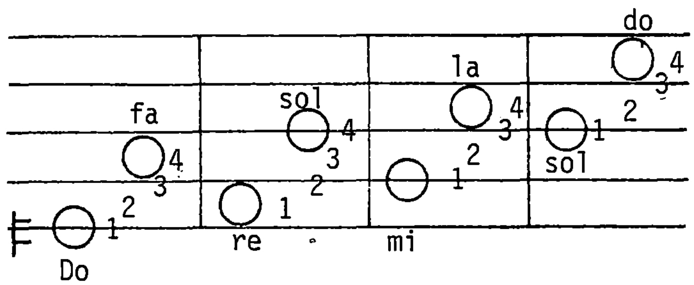
STORY NARRATIVE WORKSHEET

Name ____________________

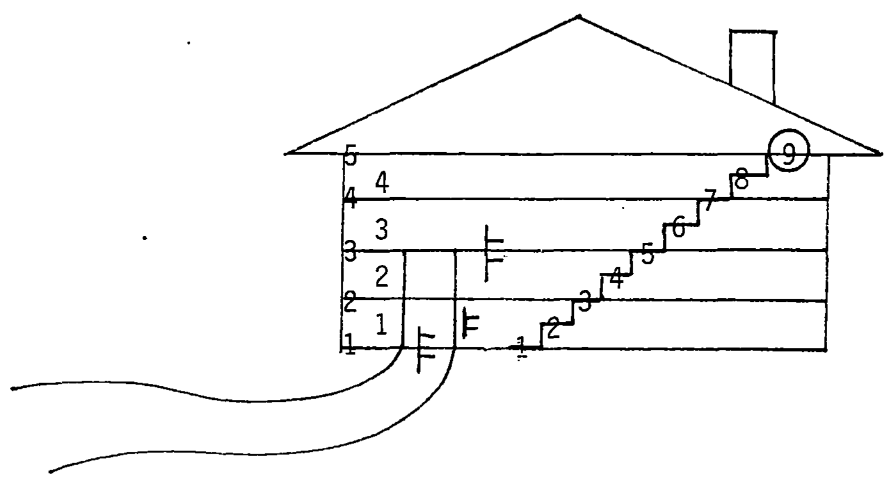
Example 1



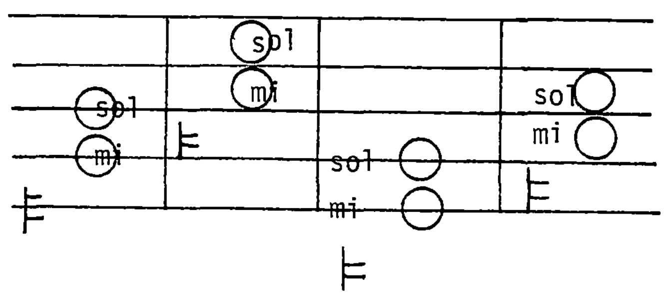
Example 2



Example 3



Example 4

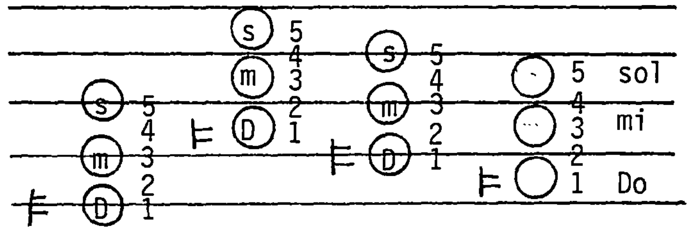


Practice A B C D

Part 1 A B C D

Story Narrative

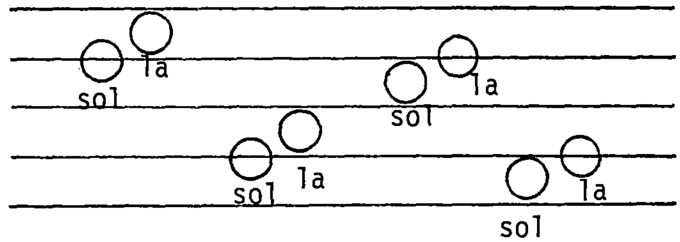
Example 5



Part 2 A B C D

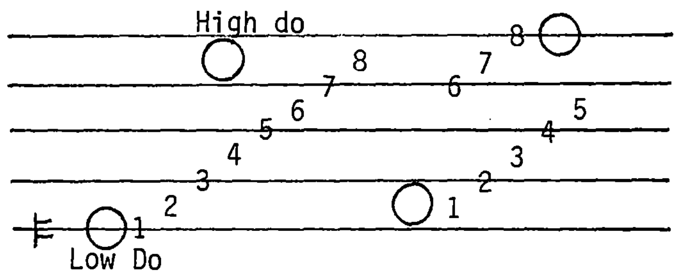
Part 3 A B C D

Example 6



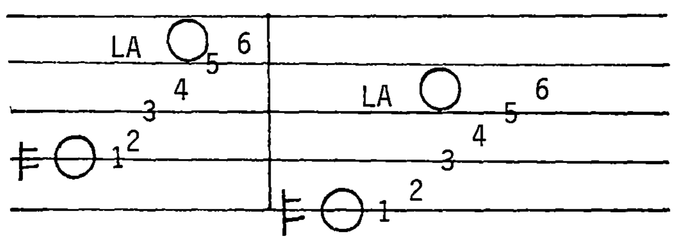
Part 4 A B C D

Example 7



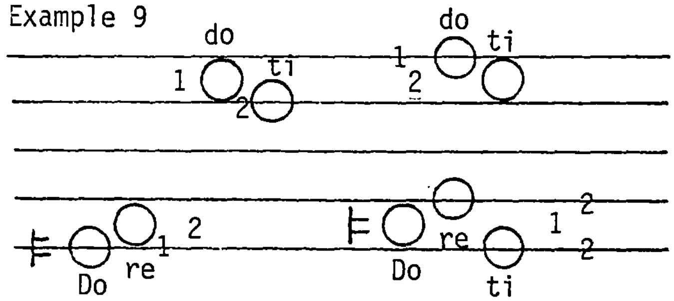
Part 5 A B C D

Example 8



Part 6 A B C D

Example 9



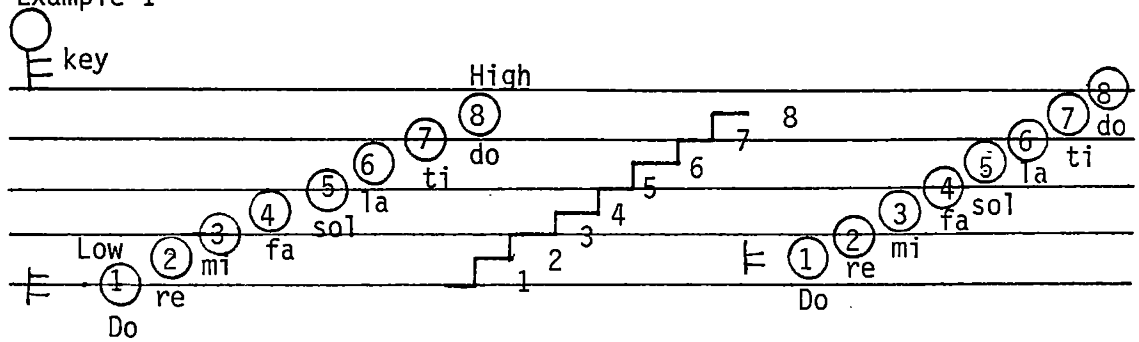
Part 7 A B C D

Name ______________________ School ______________________

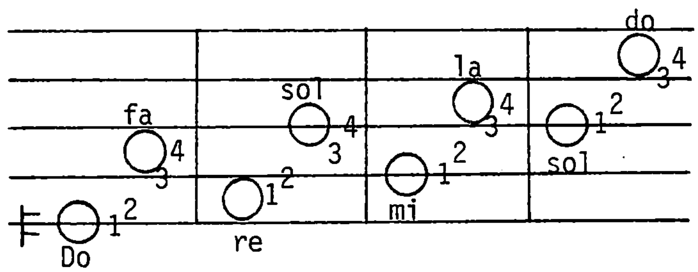
Grade ______________________ Teacher ______________________

ROTE
WORKSHEET Name ____________________

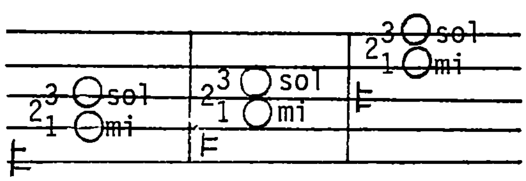
Example 1



Example 2



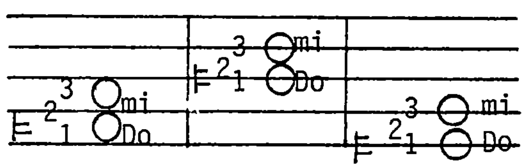
Example 3



Practice A B C D

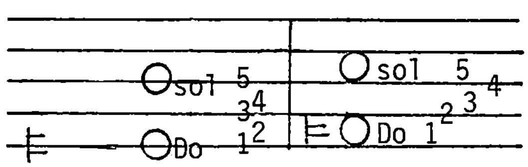
Part 1 A B C D

Example 4



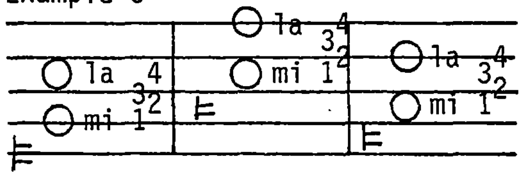
Part 2 A B C D

Example 5



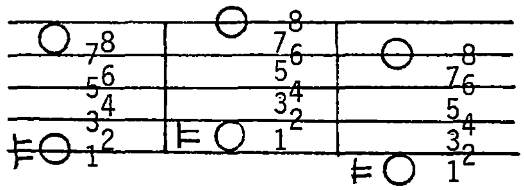
Part 3 A B C D

Rote
Example 6



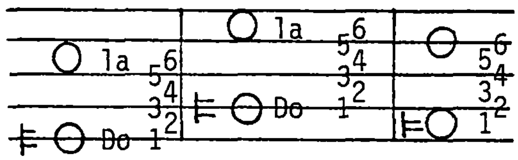
Part 4 A B C D

Example 7



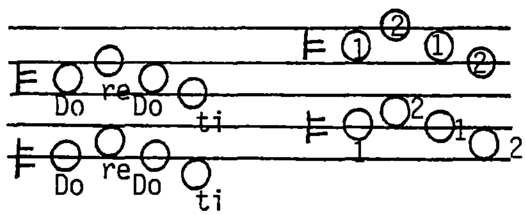
Part 5 A B C D

Example 8



Part 6 A B C D

Example 9



Part 7 A B C D

Name ____________________________

Grade ____________________________

School ____________________________

Teacher ____________________________

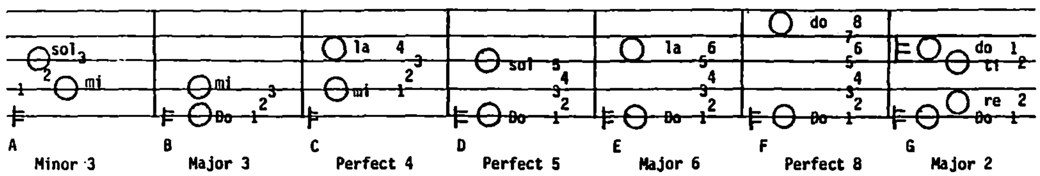
Name ______________________________

Grade ______________________________

School ______________________________

Teacher ______________________________

INTERVAL REVIEW



Practice A B C D E F G

1.	A	B	C	D	E	F	G	11.	A	B	C	D	E	F	G
2.	A	B	C	D	E	F	G	12.	A	B	C	D	E	F	G
3.	A	B	C	D	E	F	G	13.	A	B	C	D	E	F	G
4.	A	B	C	D	E	F	G	14.	A	B	C	D	E	F	G
5.	A	B	C	D	E	F	G	15.	A	B	C	D	E	F	G
6.	A	B	C	D	E	F	G	16.	A	B	C	D	E	F	G
7.	A	B	C	D	E	F	G	17.	A	B	C	D	E	F	G
8.	A	B	C	D	E	F	G	18.	A	B	C	D	E	F	G
9.	A	B	C	D	E	F	G	19.	A	B	C	D	E	F	G
10	A	B	C	D	E	F	G	20.	A	B	C	D	E	F	G

APPENDIX B

RAW DATA

TABLE VI

THIRD GRADE C^1

Story B^1						Rote B^2					
Girls A1			Boys A2			Girls A1			Boys A2		
Code	Score	Square	Code	Score	Square	Code	Score	Square	Code	Score	Square
3SG1	7	49	3SB1	3	9	3RG1	2	4	3RB1	3	9
3SG2	3	9	3SB2	3	9	3RG2	3	9	3RB2	4	16
3SG3	0	0	3SB3	2	4	3RG3	3	9	3RB3	2	4
3SG4	3	9	3SB4	3	9	3RG4	3	9	3RB4	4	16
3SG5	3	9	3SB5	2	4	3RG5	3	9	3RB5	3	9
3SG6	2	4	3SB6	2	4	3RG6	1	1	3RB6	2	4
3SG7	2	4	3SB7	3	9	3RG7	3	9	3RB7	2	4
3SG8	2	4	3SB8	2	4	3RG8	6	36	3RB8	0	0
3SG9	5	25	3SB9	2	4	3RG9	4	16	3RB9	2	4
3SG10	5	25	3SB10	3	9	3RG10	3	9	3RB10	4	16
3SG11	1	1	3SB11	2	4	3RG11	2	4	3RB11	2	4
3SG12	5	25	3SB12	3	9	3RG12	2	4	3RB12	2	4
3SG13	3	9	3SB13	2	4	3RG13	0	0	3RB13	4	16
3SG14	3	9	3SB14	3	9	3RG14	1	1	3RB14	2	4
3SG15	2	4	3SB15	0	0	3RG15	4	16	3RB15	3	9
3SG16	6	36	3SB16	2	4	3RG16	5	25	3RB16	2	4
3SG17	3.25	10.56	3SB17	5	25	3RG17	4	16	3RB17	0	0
3SG18	3.25	10.56	3SB18	6	36	3RG18	4	16	3RB18	3	9
3SG19	3.25	10.56	3SB19	2	4	3RG19	3	9	3RB19	6	36
3SG20	3.25	10.56	3SB20	2	4	3RG20	6	36	3RB20	3	9
3SG21	3.25	10.56	3SB21	3	9	3RG21	3.15	9.92	3RB21	6	36
3SG22	3.25	10.56	3SB22	7	49	3RG22	3.15	9.92	3RB22	3	9
3SG23	3.25	10.56	3SB23	4	16	3RG23	3.15	9.92	3RB23	2.81	7.89
3SG24	3.25	10.56	3SB24	7	49	3RG24	3.15	9.92	3RB24	2.81	7.89
3SG25	3.25	10.56	3SG25	6	36	3RG25	3.15	9.92	3RB25	2.81	7.89
Totals	81.25	317.06		79	323		77.75	287.61		70.43	245.69

TABLE VII

FOURTH GRADE C^2

Story B^1						Rote B^2					
Girls A_1			Boys A_2			Girls A_1			Boys A_2		
Code	Score	Square	Code	Score	Square	Code	Score	Square	Code	Score	Square
4SG1	2	4	4SB1	3	9	4RG1	2	4	4RB1	4	16
4SG2	4	16	4SB2	7	49	4RG2	4	16	4RB2	3	9
4SG3	4	16	4SB3	5	25	4RG3	4	16	4RB3	6	36
4SG4	2	4	4SB4	6	36	4RG4	2	4	4RB4	0	0
4SG5	6	36	4SB5	0	0	4RG5	2	4	4RB5	4	16
4SG6	3	9	4SB6	2	4	4RG6	2	4	4RB6	4	16
4SG7	1	1	4SB7	3	9	4RG7	4	16	4RB7	3	9
4SG8	3	9	4SB8	4	16	4RG8	4	16	4RB8	1	1
4SG9	4	16	4SB9	3	9	4RG9	4	16	4RB9	7	49
4SG10	2	4	4SB10	1	1	4RG10	1	1	4RB10	2	4
4SG11	1	1	4SB11	2	4	4RG11	3	9	4RB11	4	16
4SG12	1	1	4SB12	5	25	4RG12	1	1	4RB12	2	4
4SG13	3	9	4SB13	5	25	4RG13	2	4	4RB13	1	1
4SG14	4	16	4SB14	3	9	4RG14	3	9	4RB14	1	1
4SG15	3	9	4SB15	3	9	4RG15	4	16	4RB15	2	4
4SG16	2	4	4SB16	4	16	4RG16	1	1	4RB16	2	4
4SG17	1	1	4SB17	4	16	4RG17	3	9	4RB17	0	0
4SG18	2	4	4SB18	6	36	4RG18	4	16	4RB18	0	0
4SG19	0	0	4SB19	7	49	4RG19	3	9	4RB19	6	36
4SG20	5	25	4SB20	4	16	4RG20	7	49	4RB20	4	16
4SG21	3	9	4SB21	3	9	4RG21	4	16	4RB21	5	25
4SG22	7	49	4SB22	4	16	4RG22	4	16	4RB22	5	25
4SG23	2.86	8.18	4SB23	0	0	4RG23	1	1	4RB23	0	0
4SG24	2.86	8.18	4SB24	0	0	4RG24	3	9	4RB24	2	4
4SG25	2.86	8.18	4SH25	1	1	4RG25	3	9	4RB25	2	4
Totals	71.58	267.54		85	389		75	271		70	296

TABLE VIII

FIFTH GRADE C^3

Story B^1						Rote B^2					
Girls A^1			Boys A^2			Girls A^1			Boys A^2		
Code	Score	Square	Code	Score	Square	Code	Score	Square	Code	Score	Square
5SG1	2	4	5SB1	3	9	5RG1	3	9	5RB1	1	1
5SG2	1	1	5SB2	1	1	5RG2	3	9	5RB2	0	0
5SG3	5	25	5SB3	5	25	5RG3	4	16	5RB3	4	16
5SG4	2	4	5SB4	3	9	5RG4	3	9	5RB4	1	1
5SG5	2	4	5SB5	2	4	5RG5	3	9	5RB5	6	36
5SG6	4	16	5SB6	3	9	5RG6	2	4	5RB6	3	9
5SG7	3	9	5SB7	3	9	5RG7	7	49	5RB7	3	9
5SG8	13	69	5SB8	2	4	5RG8	4	16	5RB8	2	4
5SG9	5	25	5SB9	3	9	5RG9	10	100	5RB9	3	9
5SG10	3	9	5SB10	3	9	5RG10	4	16	5RB10	3	9
5SG11	7	49	5SB11	1	1	5RG11	4	16	5RB11	1	1
5SG12	3	9	5SB12	4	16	5RG12	2	4	5RB12	3	9
5SG13	3	9	5SB13	3	9	5RG13	6	36	5RB13	11	121
5SG14	5	25	5SB14	2	4	5RG14	1	1	5RB14	13	169
5SG15	2	4	5SB15	3	9	5RG15	2	4	5RB15	1	1
5SG16	6	36	5SB16	3	9	5RG16	1	1	5RB16	0	0
5SG17	1	1	5SB17	1	1	5RG17	3	9	5RB17	4	16
5SG18	1	1	5SB18	2	4	5RG18	2	4	5RB18	2	4
5SG19	4	16	5SB19	3	9	5RG19	2	4	5RB19	2	4
5SG20	1	1	5SB20	4	16	5RG20	1	1	5RB20	3	9
5SG21	3	9	5SB21	3	9	5RG21	3.35	11.22	5RB21	1	1
5SG22	0	0	5SB22	6	36	5RG22	3.35	11.22	5RB22	6	36
5SG23	1	1	5SB23	4	16	5RG23	3.35	11.22	5RB23	4	16
5SG24	8	64	5SB24	2	4	5RG24	3.35	11.22	5RB24	3	9
5SG25	4	16	5SB25	2	4	5RG25	3.35	11.22	5RB25	2	4
Totals	89	507		71	235		83.75	373.11		82	494

TABLE IX

SIXTH GRADE C[4]

Story B[1]						Rote B[2]					
Girls A1			Boys A2			Girls A1			Boys A2		
Code	Score	Square	Code	Score	Square	Code	Score	Square	Code	Score	Square
6SG1	0	0	6SB1	1	1	6RG1	5	25	6RB1	5	25
6SG2	4	16	6SB2	4	16	6RG2	5	25	6RB2	2	4
6SG3	4	16	6SB3	2	4	6RG3	4	16	6RB3	3	9
6SG4	3	9	6SB4	2	4	6RG4	3	9	6RB4	1	1
6SG5	1	1	6SB5	7	49	6RG5	2	4	6RB5	4	16
6SG6	2	4	6SB6	2	4	6RG6	6	36	6RB6	3	9
6SG7	3	9	6SB7	3	9	6RG7	3	9	6RB7	4	16
6SG8	3	9	6SB8	7	49	6RG8	3	9	6RB8	2	4
6SG9	3	9	6SB9	3	9	6RG9	9	81	6RB9	2	4
6SG10	3	9	6SB10	1	1	6RG10	2	4	6RB10	5	25
6SG11	6	36	6SB11	1	1	6RG11	0	0	6RB11	4	16
6SG12	6	36	6SB12	3	9	6RG12	3	9	6RB12	4	16
6SG13	5	25	6SB13	6	36	6RG13	0	0	6RB13	5	25
6SG14	3	9	6SB14	5	25	6RG14	2	4	6RB14	2	4
6SG15	7	49	6SB15	4	16	6RG15	4	16	6RB15	3	9
6SG16	2	4	6SB16	2	4	6RG16	3	9	6RB16	4	16
6SG17	1	1	6SB17	3	9	6RG17	3	9	6RB17	3	9
6SG18	2	4	6SB18	1	1	6RG18	2	4	6RB18	5	25
6SG19	3	9	6SB19	3	9	6RG19	3	9	6RB19	2	4
6SG20	6	36	6SB20	2	4	6RG20	3	9	6RB20	3	9
6SG21	5	25	6SB21	5	25	6RG21	3	9	6RB21	5	25
6SG22	3.42	11.69	6SB22	5	25	6RG22	5	25	6RB22	3	9
6SG23	3.42	11.69	6SB23	1	1	6RG23	5	25	6RB23	4	16
6SG24	3.42	11.69	6SB24	4	16	6RG24	4	16	6RB24	2	4
6SG25	3.42	11.69	6SB25	3.20	10.24	6RG25	4	16	6RB25	2	4
Totals	85.68	362.79		80.20	327.24		86	378		82	304

APPENDIX C

FREQUENCY RESPONSES FORM B AND KUDER-RICHARDSON RELIABILITY FORMULA

TABLE X

FREQUENCY RESPONSES FORM B

Response Letter	Interval	Question Item Number	Total Correct Responses
A	Mi3	1	60
		9	63
		15	52
B	M3	7	76
		14	63
		20	59
C	P4	6	59
		13	76
		19	76
D	P5	2	88
		10	90
		16	58
E	M6	3	59
		11	68
		17	60
F	P8	5	68
		8	67
G	M2	4	50
		12	40
		18	50

Source: Kuder-Richardson-21 (Gay, 1976, p. 95).

$$r_{total\ test} = \frac{(K)(SD^2) - \bar{X}(K - \bar{X})}{(SD^2)(K-1)}$$

where K = the number of items in the test,
SD = the standard deviation of the scores, and
$\bar{X}$ = the mean of the scores.

$$(20)(3.60) - 3.16(20-3.16) \doteq$$

$$\frac{72 - 53.21}{68.4} = \frac{18.79}{68.4} = .28$$

$$SD^2 = \frac{\Sigma x^2 - \frac{(\Sigma x)^2}{N}}{n-1} = \frac{5506 - \frac{(1282)^2}{406}}{405} = 3.60$$

$$\bar{X} = \frac{1282}{406} = 3.16$$

VITA

Nedra Koen Roye

Candidate for the Degree of

Doctor of Education

Thesis: MEMORY--A COMPARISON OF ROTE REHEARSAL VERSUS THE STORY NARRATIVE MNEMONIC FOR THE RECOGNITION, IDENTIFICATION, AND RECALL OF MUSICAL INTERVALS

Major Field: Curriculum and Instruction

Biographical:

Personal Data: Born at Mexico, Missouri, April 27, 1943, the daughter of George D. and Ruth N. Koen.

Education: Graduated from Mexico High School, Mexico, Missouri, in May, 1961; received Bachelor of Education degree in Music Education from the University of Missouri in June, 1964; received Master of Education degree from the University of Missouri in July, 1968; completed requirements for the Doctor of Education degree at Oklahoma State University in December, 1986.

Professional Experience: Taught music at Hallsville, Missouri, 1964-1966; music instructor at Ashland, Missouri, 1966-1968; taught vocal music at Stillwater High School, 1968-1969; classroom instructor in open space concept school, Skyline Elementary, 1970-1981; elementary music instructor, Miami, Oklahoma, 1981-1986; served on various educational committees; participated in economic education development contest, 1976; in-service instructor for staff development, 1984-1985.