THE RELATIONSHIP OF TEMPO, PATTERN LENGTH, AND GRADE LEVEL ON THE RECOGNITION OF RHYTHM PATTERNS

by

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Dissertation submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of
DOCTOR OF EDUCATION
in
Curriculum and Instruction

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May, 1988

Blacksburg, Virginia

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(ABSTRACT)

The purpose of this study was to investigate the effects of tempo, pattern length, and grade level on student ability to recognize rhythm patterns. It was intended that the study would also determine if age and experience are factors which affect rhythm recognition and memory. A 48 item Rhythm Pattern Identification (RPI) test was administered to 2146 band students and 114 nonmusic students in grades 6 through 12. The RPI consisted of 48 pairs of rhythm patterns varied in time length (seconds), number of note values (sound events), and tempo. Students indicated if the pairs of rhythm patterns were the same or different.

Statistical analysis indicated the reliability estimate (KR-20) of the RPI to range from .445 to .792 with the median being .553. Criterion related validity was established through a correlation of student scores on the Iowa Tests of Music Literacy (Gordon, 1970) and the RPI, $\underline{r}$ = .39. A multiple regression analysis of the data indicated that .36 of the variance in the RPI scores was attributable to the linear combination of tempo, length in seconds, number of sound events, and grade level. As expected, the independent variables of length in seconds and length in sound events were significantly correlated $\underline{R}$ = .63; however, there were

no significant correlations between the other independent variables. Inverse relationships were found between tempo and score and length and score. Beta weights indicated that the number of sound events was the most significant influence on student scores. Data indicated a slight increase in score from one grade level to the next with significant differences occurring between grades six and eleven and twelve and between grades seven and eleven and twelve.

The results of the study indicate that length of pattern in seconds, number of sound events, tempo, and grade level all affect memory of rhythm patterns. These findings corroborate with those of Dowling (1973), Sink (1983), and Fraisse (1982). The implications for music education are: (1) tempo may be a factor that influences how students learn rhythm and (2) student perception of rhythm may be more affected by the length of the rhythm pattern in number of sound events rather than the length of a pattern in seconds. Future research should include further investigation of young students ability to comprehend rhythm patterns. It is evident that young students can perceive and recognize as complex patterns as older students.

ACKNOWLEDGEMENTS

The completion of this dissertation would not have been possible without the continued guidance and support of my committee members, colleagues, students, and family. I would like to express my gratitude to my committee members: Dr. Vernon Burnsed, Dr. Thomas Teates, Dr. Dennis Hinkle, Dr. John Burton, and Dr. Norman Dodl for their guidance throughout this project. A special thank-you to Vernon Burnsed for the many afternoon rap sessions of listening, questioning, writing, and rewriting. His help and support were invaluable.

Thanks to my colleagues for their help in administering this project and especially to Bill Ray and Steve King for their 'listening ears' throughout the development and completion of my study. Hats off to Bill Ray for his many offers of "How can I help?".

Thank you to the Blacksburg band students who in their own special way contributed to this research. It was through teaching and working with these students that the ideas for my study took shape.

To my parents, Robert and Edna Love, and brothers, Bob and Dennis, and niece, Lindsey, much love and gratitude for their continued support and encouragement.

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CHAPTER I. INTRODUCTION AND RELATED LITERATURE

Today, cognitive psychology is one of the major fields of study in educational research. With the growth of knowledge in this area, more and more researchers are applying what has been learned in the laboratory setting to actual classroom situations. There has been an increased interest in the developmental aspects of cognition due to the concern of how people deal with meaningful and extended information. One discipline which can benefit from this growth is music cognition. Cognitive psychology of music is a growing discipline and "...one in which several areas of inquiry have yet to receive attention." (Slobda, 1986, p. 9)

One aspect of music teaching in which the cognitive process of learning can be applied is that of rhythmic performance and understanding. Because music consists of phrases of tonal and rhythm patterns, students who learn to perform in a musical manner need to learn to read from pattern to pattern rather than from note to note. Support for this principle can be traced back to the teachings of Lowell Mason in the 1830's who put into practice a whole-part-whole method for learning to read music through singing. He urged teachers to teach sound before signs and to make children learn to sing before learning written notes. (Schleuter 1984) Other educators such as Kodaly and Gordon have applied the same principles of learning in their teaching techniques. The Kodaly method and Edwin Gordon method employ sequences of tonal and rhythmic patterns for learning music. (Chosky, 1974; Gordon, 1984)

The underlying organizing factor of nearly all instrumental music method books is rhythm content. However, most methods of instruction emphasize the learning of single note values and systems of counting rather than how the notes are combined to create rhythm patterns. For example, in Sessions in Sound (Buehlman & Whitcomb, 1976) and in Band Today (Ployhar, 1977) students begin their study with whole notes and whole rests and continue to the smaller note values. The idea of rhythm patterns is discussed briefly near the end of these books or not at all. As stated by Schleuter (1984), many problems occur in instrumental music instruction because common practice begins with symbols rather than sounds. When a functional rhythm pattern vocabulary is developed, then music takes on a meaningful dimension of understanding. An analogy of learning sequence in music is the process by which children acquire language facility. Learning to read and comprehend a language has many similarities to learning to read and comprehend music. Music is first heard and experienced and only after the aural experience can visual symbols have meaning. One needs to have an understanding of the human information processing system as it relates to the learning of rhythm patterns in order to develop a method of rhythm pattern instruction.

RELATED LITERATURE

The cognitive processing of rhythm involves several stages which include information input, storage, and utilization. The input stage involves the sensory reception of the sound which is encoded and entered

into the brain (perception stage); the storage of the information involves memory (enters short term memory as bits of information and with practice is encoded into the long term memory); utilization involves a decision stage, a retrieval or decoding stage, and an output stage where some music response is made. (Reed, 1982)

Research in the area of music cognition includes studies which concern tonal and rhythmic pattern memory. The studies reviewed in this paper focus on the element of rhythm alone or in combination with tonal material. One of the earliest studies in rhythm cognition dates back to James (1890) who observed that familiar melodies can be recognized by rhythm alone. This was later documented in a study by White (1960). Fiske (1976) found that reaction time to errors in pitch or rhythm was reduced when the two elements were presented together. Schellenberg and Moore (1985) investigated the effects of tonal-rhythmic context on memory for rhythm and pitch sequences. Their results also showed that memory for both pitch and rhythm were aided when they were in a rhythmic-tonal context. They concluded that both rhythm and pitch sequences are "...important to the STM (short term memory) process for melody with each enhanced by the presence of the other" (Schellenberg & Moore, 1985, p. 215). Steedman (1977) found that repetition of tonal patterns can act as a cue for meter while rhythmic stress provides cues for determining tonal structure. Carterette, Monahan, Holman, Belle and Fiske (1983) showed that listeners who were given brief melodies for multidimensional scaling found rhythm more important than pitch in organizational factors.

Several studies have dealt with rhythmic and tonal groupings and pattern length. The basic premise of most of these studies can be traced to the work of Miller (1956). He determined the amount of information that can be processed in STM and developed the 'limited processing' or 'channel capacity' theory. He found that the human mind has the capacity to process approximately seven bits or chunks of information and that this capacity could be increased by recoding or regrouping items. This theory of 'chunking' has been applied by several researchers in their music cognition studies.

Dowling (1973) found Miller's theory useful in demonstrating the effects of rhythmic grouping or chunking in melodies. In his experiment, subjects were presented a series of twenty tones which were divided into five note rhythmic phrases. After listening to the phrases the subjects were to indicate if the notes were contained in the phrase. The test item either corresponded rhythmically to one of the phrases in the list (within items) or consisted of the last three notes of one phrase and the first two notes of the next item (across items). Presentation of the material was given at a fast and a slow rate to test for the possibilities that

> "...a fast presentation might be easier because faster groups form more cohesive units (Gestalt) and thus are easier remembered or that slower patterns might be easier because of the longer time to assimilate information (encoding and rehearsal)." (Dowling, 1973, p. 37)

Results supported the position that the subjective chunking and memory storage is determined by the rhythmic grouping of input. In dealing with the rate of presentation Dowling also found a slight superiority of slow presentation to fast presentation suggesting that encoding or rehearsal

time may be as important in the memory of melodies as it is in the memory of verbal material.

Williams (1975) suggested that loss of memory for pitch was due to the function of melody length rather than time delay. He found that there was 95% accuracy in the recall of the last tone of a sequence regardless of the sequence length. Accuracy for recall of the first tone or center tone of a sequence decreased as the sequence length increased. From these results Williams concluded that loss of information from the middle of the melody depends on the length of the sequence and not the time delay.

Deutsch (1972) demonstrated grouping by four in a passage where pitch contour was naturally grouped by three could make memory for that passage more difficult. She also found that segmenting a melody with no inherent pitch grouping into groups of three or four notes resulted in these groups being perceived as subjective groups.

Smith (1983), in a comparison of musicians vs. nonmusicians, found that musicians tended to group rhythmic patterns by meter while nonmusicians did not. Deutsch (1982), in asking musicians to recall melodies by dictation, found that those melodies with an organized structure could be recalled with 95% accuracy while those without structure could be recalled with only 52% accuracy. The performance rose to 99% when the structural melodies were segmented into groups of three. If the melodic groups were broken into four segments performance dropped to 69%. Several studies confirm the importance of the 'hierarchial organization' in the perception of rhythm and memory. (Handel & Todd, 1981)

Sink (1986) investigated the effects of rhythmic and melodic alterations on rhythmic processing. The results of his work demonstrated that perception of rhythmic dissimilarity is affected by rhythmic and melodic alterations and that simultaneous presentation of rhythm and melody may result in reduced attention to absolute rhythmic structure. Implications for music education suggested by Sink were that rhythmic and melodic phrase patterning, monotony, alterations in tempo, and duration and pitch characteristics may serve as organizers of rhythm. The importance of each organizer for subjects depends on their past musical experiences (instrumental training) and the ordering of the rhythmic and tonal information. Subjects used two processing strategies; one related to characteristics within the pattern and the other related to characteristics of the whole pattern (melodic and rhythmic). Sink suggested that it may be beneficial to teach concepts relating to rhythm in monotonic rather than melodic context. Fraisse (1982) has conducted many studies which deal with rhythm and rhythmic perception. Through his research on rhythm and structure he has established three principles of rhythmic pattern grouping:

1. "tones that are separated by short intervals are perceptually grouped together,
2. the first tone of a perceptual group is a tone that is immediately preceded by a long interval, and
3. long tones are perceived as accented and short tones are perceived as unaccented." (p. 179)

Fraisse also concluded that it is easier to perceive a temporal form which is brief and simple. He found that certain simple patterns are easier for listeners to process than others. For example a pattern with

the temporal ratio of 2:1 between the rhythmic elements is perceived and reproduced easier than a pattern with a 3:1 ratio. This temporal ratio of 2:1 was also confirmed by Povel (1981) who concluded that there were two steps involved in the listener's encoding of a rhythmic pattern. He found that the listener attempts to find a regular beat pattern (cannot be longer than 1.5 sec or tempos slower than 40 beats/min.) and that the beat intervals are divided into patterns having an equal subdivision or in a 2:1 ratio. Mac Dougall (1903) found that more complex groups of notes can be distinguished if they are subgrouped into smaller units. He determined that the length of music phrases generally does not exceed five seconds in length with three seconds being the most common phrase length. Royer and Garner (1966) found that simple patterns can be organized quickly while more complex patterns take longer. They concluded that perceptually good patterns should have few alterations and that two to three notes per second is the optimum number for a good pattern.

Studies in the development of musical behavior have dealt with musical memory and auditory perception of rhythms in young children. In 1966 Bentley's study showed that students age 7 to 14 found rhythm memory easier than tonal memory. His data indicated that memory for rhythm patterns develop earlier than other aspects of music ability and that most children have reached the rhythm analysis stage by the age of eight. Petzold (1963) looked at differences in the ways in which children in grades one through six perceive and respond to the presentation of musical sounds. Results showed a plateau effect of learning with the main differences occurring at a three year interval. Gordon (1984) has done ex-

tensive research in the musical development of young children. He has investigated musical aptitude in children and has devised a number of musical aptitude tests. These include: Primary Measures of Music Audiation (Gordon, 1979), Intermediate Measures of Audiation (Gordon, 1982), and Musical Aptitude Profile (Gordon, 1965). Gordon has formulated a learning theory for tonal and rhythm pattern instruction based upon the principle of "audiation." His basic premise is that students must be able to internalize (audiate) aural patterns before they can perform the patterns.

SUMMARY

In general, conclusions of these studies indicate that rhythm and tonal pattern memory can be influenced by note grouping, rate of presentation, and pattern length in both time and number of tones. It appears that the information concerning rhythm pattern length and tempo may be applicable to the teaching of rhythm. By applying what has been tested in other studies to an instructional situation, one may gain a better understanding of how students process rhythm. Implications for music education are:

1. Students' ability to understand or process rhythm may depend on how it is taught. They may have a better concept of rhythm if it is taught in patterns rather than from note to note.

2. Tempo may be a factor which influences how students learn rhythm. They may learn rhythm patterns better at a slow rate of presentation.

3. The length of the rhythmic pattern in seconds may be more important than the number of notes in a pattern. Students may be better able to process patterns that are 2-3 seconds in length rather than those of 4-5 seconds. The number of tones in the pattern may not matter as long as the pattern does not exceed a certain length of time.

Understanding the way in which the factors of tempo and length affect one's ability to process rhythm patterns may lead to new instructional methods for teaching rhythm reading.

CHAPTER II. PILOT STUDY

The purpose of the pilot study was to investigate the influence that pattern length and rate of presentation have on recognition of music patterns in a music education environment. Attention was focused specifically on students' abilities to process rhythm patterns in terms of length in seconds, length in number of sound events, and tempo. In addition, it was intended that this study would determine if grade level was a factor which related to rhythm memory. The specific research questions addressed in this study were:

1. What is the effect of tempo on the recognition of rhythm patterns?

2. What is the effect of pattern length in seconds on the recognition of rhythm patterns?

3. What is the effect of the number of sound events on the recognition of rhythm patterns?

4. What is the relationship of grade level to the recognition of rhythm patterns?

An important part of this study was to develop a measurement instrument to measure recognition of rhythm patterns. Although there were tests available that measure rhythm perception, none were designed according to the factors of length, tempo, and grade level.

PROCEDURES OF PILOT STUDY

A 48 item, Rhythm Pattern Identification (RPI) test was developed by the researcher to test music students' short term memory capacity for rhythm patterns. Each item consisted of two rhythm patterns. Student participants had to indicate if the patterns were the same (S) or different (D). Factors considered in designing the test were: length of pattern in seconds, length of pattern in number of sound events, and rate of presentation. The rhythm patterns were 2 to 5 seconds in length (3-5 seconds is the usual length of a rhythm phrase (Mac Dougall, 1903) with 2-4 sound events occurring per second (2-3 is the optimum [Royer & Garner, 1966]). The rates of presentation were 60 MM (metonome marking), 80 MM, 100 MM, and 120 MM (beat intervals slower than 40 MM lose cohesiveness of pattern [Povel, 1981]). The rhythm patterns selected to meet these criteria were taken from a table of rhythm patterns from five beginning band publications (Pottenger, 1969) and were presented in random order. The rhythms which were recorded on a cassette tape were played on a synthesizer on a single tone so that timbre, dynamics, pitch, and articulation were constant for each pattern.

The 48 items on the RPI test had the following characteristics:

1. length in seconds (2,3,4,5)- 12 items of each

2. number of sound events (2,3,4 per second)

number of sound events	number of items
20	4
16	4
15	4
12	8
10	4
9	4
8	8
6	8
4	4

3. tempo (60, 80, 100, and 120 MM)- 12 items of each

The rhythm patterns selected for this study were based on a combination of patterns presented in Pottenger's table of rhythm patterns (Pottenger, 1969). Rhythms contained in the patterns included the following note values:

To insure random placement, all test items were numbered and then the numbers were drawn from a hat. The patterns were played on a Yamaha Synthesizer and recorded on an Akai stereo cassette tape deck. Each pattern was played on a single pitch followed by a three second pause and then a pattern that was either the same or different. A coin was tossed to determine if the selection pattern would be the same or different from the original pattern.

The Rhythm Pattern Identification test was administered to 336 band students enrolled in grades six through twelve at one middle school and one high school located in a rural college community. The test was given at the beginning of the school year during the regularly scheduled band class and was administered by the researcher and the middle school band director. Each student was given an answer sheet and directed to complete information concerning age, sex, grade, and experience. Students were then told to listen to the tape recorded test and complete the answer sheet as directed. To assure consistency in how the instructions were given, all directions on how to complete the test were given on the tape recording. The test required ten to twelve minutes to complete. To investigate the validity of the RPI, students were also administered the rhythm reading recognition section of the Iowa Tests of Music Literacy (Gordon, 1970).

RESULTS OF PILOT STUDY

Statistical analysis consisted of a multiple regression analysis. The criterion variable was score which was the percentage of correct responses for each item on the test. The predictor variables were: tempo, length in seconds, number of sound events, and grade level. Results of the multiple regression analysis (table 1) show that (R2 =.32) the total variance of score was due to the combination of the independent variables. Of these variables, length in seconds was the best predictor (-.32) followed by grade level (.27), tempo (-.22), and number of sound events (-.15).

As shown in table 2, the independent variables of length in seconds and number of sound events were highly correlated (.66); however, there was not a strong linear relationship between the other independent variables.

This indicates that there were three distinct variables (length, grade, and tempo) which were substantially correlated with the dependent variable and not highly correlated with each other. The reliability estimate (KR-20) was .643 which compares favorably with other tests of this type including the rhythm tests of the Iowa Tests of Music Literacy (Gordon, 1970) and the Intermediate Measures of Music Audiation (Gordon, 1982). A correlation of student scores on the Iowa Tests of Music Literacy and the RPI revealed a relationship (r = .39) which along with the related literature supported the construct validity of the RPI.

Table 1. Multiple Linear Regression

Dependent Variable: Score R & R-SQUARE:	0.5696	0.3245	
PREDICTOR	B COEFFICIENT	BETA	P<
GRADE LEVEL	2.1120	0.2725	.05
NO. OF SOUND EVENTS	-0.5453	-0.1597	.05
LENGTH IN SECONDS	-4.7951	-0.3249	.05
TEMPO	-0.1508	-0.2211	.05
CONSTANT	89.0790		

Table 2. Means, Standard Deviation, and Correlation Matrix for RPI Test Items

VARIABLE	MEAN	STD. DEV.
NO. OF SOUND EVENTS	10.60	4.55
LENGTH IN SECONDS	3.60	1.05
TEMPO	89.58	22.76
GRADE LEVEL	9.00	2.00
SCORE*	71.54	15.53

Number of Cases: 336

LABEL	SOUND	LENGTH	TEMPO	SCORE	GRADE
NO. OF SOUND EVENTS	1.00	0.66	-0.03	-0.37	0.00
LENGTH IN SECONDS		1.00	-.03	-0.44	0.00
TEMPO			1.00	-0.23	0.00
GRADE LEVEL				0.27	1.00
SCORE*					0.27

SCORE*= percentage of correct responses for each item

CONCLUSIONS OF PILOT STUDY

The pilot study was similar to previously reported research in that it investigated rhythm patterns in the terms of length in seconds, of length in number of sound events, and of different rates of presentation. The pilot study differed from most of the reported research in that it was applied to a classroom rather than a laboratory situation and that it examined all three of these factors in combination as well as individually. In addition, the pilot study deal with rhythm alone and did not attempt to examine rhythm in combination with pitch.

As shown in the results, length, grade level, and tempo were all factors which affect memory of rhythm patterns. These findings correlate with those of Dowling (1973), Sink (1984), and Fraisse (1982). The data indicated that there was an inverse relationship between tempo and score. As suggested by Dowling, the slower tempo may allow for the individual to encode the pattern, thus aiding in one's memory. The data also indicated an inverse relationship between the length of patterns and the number of correct responses. This supports Fraisse's findings that it is easier to perceive a temporal form which is brief and simple.

There was a slight grade effect with an increase in score from one grade level to the next. However, there was not a great range of scores across grade six through eight nor across grades nine through twelve. Future investigation should determine if these rather restricted differences between grade levels represent a general characteristic.

Results of this study indicated that the RPI test is a feasible way to measure rhythm recognition. The tentative conclusions which need further investigation were:

1. Tempo may be a factor which influences how students learn rhythm.

2. The length of the rhythm pattern in seconds may be more important than the number of notes in the pattern.

3. A larger number of students from a varied demographic area should be tested to better substantiate the findings.

4. A comparison should be made between band students and nonmusic students to see if there is a difference between the two groups' ability to recognize rhythm patterns.

CHAPTER III. RELATIONSHIP OF TEMPO, PATTERN LENGTH, AND GRADE LEVEL

As suggested by the literature review and results of the pilot study this investigation was designed to determine the effects of tempo, pattern length, and grade level on student ability to recognize rhythm patterns. It was intended that the study would also determine the relationship between grade level and rhythm recognition and memory and determine if there are differences between band students' and nonmusic students' abilities to recognize rhythm patterns. In addition, missed test items would be examined to determine which factors contributed to rhythm pattern difficulty. The specific research questions to be addressed were:

1. What is the effect of tempo on the recognition of rhythm patterns?

2. What is the effect of pattern length in seconds on the recognition of rhythm patterns?

3. What is the effect of the number of sound events on the recognition of rhythm patterns?

4. What is the relationship of grade level to the recognition of rhythm patterns?

5. What are the differences between band and nonmusic students' recognition of rhythm patterns?

PROCEDURE

The Rhythm Pattern Identification (RPI) test, which was developed in the pilot study, was modified for this research. The test consisted of 48 items with each item containing two rhythm patterns. Students had to indicate if the patterns were the same (S) or different (D). The items varied in length in seconds, number of sound events, and tempo. The RPI test used for this research differed from the one used in the pilot study in that the 48 rhythm patterns were performed on a computer. The rhythms were played on an Apple IIE computer using the Roland-Compu software program and were recorded on an Akai cassette recorder. The computer was used to insure that timbre, dynamics, pitch, and articulation were constant for each pattern; and to eliminate human error in tempo and rhythmic accuracy. In addition, four different forms of the test were created to control the effects of pattern order. All items were numbered and then the numbers drawn from a hat to insure random placement. This was done for all four test forms.

The test was administered to students in grades 6-12 who were from varied demographic areas and socio-economic levels. The subjects tested included 2146 band students and 114 nonmusic students who were enrolled in public schools in Virginia. The 36 schools selected for the study were members of the District VI music region of the state which included schools in the cities of Danville, Lynchburg, Radford, Roanoke, and Salem; and in the counties of Bedford, Campbell, Halifax, Montgomery, Patrick, and Pulaski.

Each band director was contacted initially by phone and then sent a letter requesting his/her participation in the study. The initial letter was followed by an RPI test packet which included directions, score sheets, student information forms, test tape, and a questionnaire concerning equipment used and problems encountered in testing. (Appendix A) The test (Appendix B) was administered by the director of each group. The test administrators' responsibilities were to hand out all test forms, play the cassette test tape, and complete the form concerning equipment used and problems encountered in the test administration. All directions for the RPI test were given on the test tape to insure consistency in how instructions were given.

In order to compare the test results of band and nonmusic students, directors at five schools were requested to administer the test to nonmusic students. It was suggested that this be done during a study hall class period.

Due to the size of the sample tested and the geographic area encompassed, it is reasonable to assume that the data specific to this sample may be representative of students in other areas of the country. However, further studies would have to be conducted to justify this assumption.

RESULTS

Analyses revealed the reliability estimate (KR-20) of the RPI to range from .445 to .792 with the median being .553. In addition, in the pilot study a correlation of student scores on the Iowa Tests of Music Literacy

(Gordon, 1970) and the RPI revealed a relationship of ($\underline{r}$ =.39, n=300, p< .05) which along with the related literature supported the construct validity of the RPI.

Of the 36 schools selected for the study, responses were received from 27. Data from four of the responding schools were unusable because of the following reasons: one school failed to complete the forms correctly as to grade and student ID; the symphonic band results of another school were discarded because students did not have time to finish the test due to early dismissal; the data from two other schools were deleted due to test problems indicated by the directors.

Five schools returned data for nonmusic students for grades 8, 10, 11, and 12. Data for the grade 10 nonmusic students were deleted due to the small sample number (n=7). The scores of 2006 band students and 107 nonmusic students were used to complete the analyses reported for this study.

The dependent variable for this study was score, which was the percentage of correct responses for each item on the test. (Appendix C reports scores for each item by grade level.) The independent variables were: tempo, length in seconds, number of sound events, and grade. To determine the influence of the independent variables on the dependent variable, a multiple regression analysis was used (table 3). Results of the multiple regression analysis show ($\underline{R2}$ =.36) the total variance of the score was due to the combination of the independent variables. Of these variables, number of sound event was the best predictor (-.30), followed by length in seconds (-.28), grade (.21), and tempo (-.17).

Table 3. Multiple Linear Regression

Dependent Variable: Score R & R-SQUARE:	0.6001	0.3602	
PREDICTOR	B COEFFICIENT	BETA	P<
GRADE LEVEL	1.6388	0.2101	.05
NO. OF SOUND EVENTS	-1.0997	-0.3026	.05
LENGTH IN SECONDS	-4.3000	-0.2854	.05
TEMPO	-0.1213	-0.1767	.05
CONSTANT	98.3794		

To determine where differences occurred between grades the Tukey post hoc multiple comparison procedure was conducted on the score means of the seven grade levels; these means are found in table 4. Although there was a slight increase in score from one grade level to the next, results of the Tukey test indicated that significant differences existed only between grades six ($\bar{X} = 69.53$) and eleven ($\bar{X} = 78.59$) and twelve ($\bar{X} = 78.76$) and between grades seven ($\bar{X} = 70.85$) and eleven and twelve.

As shown in the summary table (table 5), the independent variables of length in seconds and number of sound events were highly correlated (.63); however, there is not a strong linear relationship between the other independent variables.

This indicates that there are three distinct variables (length, grade, and tempo) which are substantially correlated with the dependent variable and not highly correlated with each other.

An independent t-test was used to compare the mean scores of the nonmusic (n=107) and band (n=777) students in grades eight, eleven and twelve. Results showed a significant difference in scores of the two groups (Table 6). The t-scores for all groups exceeded the critical value. The band students scored significantly higher than nonmusic students on the test. The assumption of equal variances was tested and found to be valid.

Table 4. Results of Tukey Post Hoc Comparison Test

GRADE LEVEL MEANS	6	7	8	9	10	11	12
	69.57	70.85	74.03	74.79	76.87	78.59	78.76
Q Values							
6		.69	2.43	2.85	3.99	4.93*	5.02*
7			1.74	2.15	3.29	4.23*	4.32*
8				.42	1.55	2.49	2.58
9					1.14	2.08	2.15
10						.94	1.03
11							.89
12							

*Critical Value: 4.17 P< .05

Table 5. Means, Standard Deviation, and Correlation Matrix for RPI Test Items

VARIABLE	MEAN	STD. DEV.
NO. OF SOUND EVENTS	10.89	4.29
LENGTH IN SECONDS	3.60	1.04
TEMPO	89.58	22.76
SCORE*	74.78	15.62
Number of Cases: 336		

LABEL	SOUND	LENGTH	TEMPO	GRADE	SCORE
NO. OF SOUND EVENTS	1.000	.637	-.020	.000	-.481
LENGTH IN SECONDS		1.000	.037	.000	-.485
TEMPO			1.000	-.000	-.181
GRADE LEVEL				1.000	.210
SCORE*					1.000

SCORE*= percentage of correct responses for each item

Table 6. T-Test Comparison of Nonmusic and Band Students

Group		Nonmusic			Band			
Grade	N	Mean	SD	N	Mean	SD	t	P<
8	58	32.78	4.58	482	34.56	4.70	-2.96	.05
11	27	34.15	4.27	119	37.31	3.88	-3.85	.05
12	22	34.68	5.64	67	37.47	3.22	-2.32	.05
Total	107	33.86	4.89	777	36.44	4.06	-5.61	.05

CHAPTER IV. DISCUSSION

The purpose of this study was to investigate the effects of tempo, pattern length, and grade level on student ability to recognize rhythm patterns. The specific research questions addressed were:

1. What is the effect of tempo on the recognition of rhythm patterns?

2. What is the effect of pattern length in seconds on the recognition of rhythm patterns?

3. What is the effect of the number of sound events on the recognition of rhythm patterns?

4. What is the relationship of grade level to the recognition of rhythm patterns?

5. What are the differences between band and nonmusic students' recognition of rhythm patterns?

As shown in the results, length in seconds, number of sound events, grade, and tempo are all factors which affect recognition of rhythm patterns. These findings correlated positively with those of the pilot study and those of Dowling (1973), Sink (1984), and Fraisse (1982). The data indicated that there was an inverse relationship between tempo and score. As suggested by Dowling, the slower tempo may allow for the individual

to encode the pattern, thus aiding in one's memory. As with tempo, there was an inverse relationship between the length of patterns and the number of correct responses. This supports Fraisse's findings that it is easier to perceive a temporal form which is brief and simple. Williams (1975) also found that the length of a pattern influenced the amount of information retained. The longer the pattern the more information lost. In terms of grade levels, it was found that the means of the total group were higher at each successive grade level (see table 4); however, there were no significant differences between the first five grade levels (6 through 10). There were significant differences between grades six and eleven and twelve and between grades seven and eleven and twelve. This is similar to the findings in Petzold's (1963) study with elementary students where there was a difference for a three year interval. Results of this study suggest that students in grade six may perceive rhythm patterns as well as those students in grades seven, eight, nine, and ten. It was suggested in Bentley's (1966) study that most children by the age of eight have reached the stage of analysis in rhythmic memory. He found that they can remember sufficient detail in a rhythm pattern to locate where a change may occur in a second presentation of the pattern.

As one would expect there was a difference in the scores of the band and nonmusic students indicating that instruction may be a factor in student scoring. Similar results were found by Sink and Smith. Sink (1983) found that subjects depend on their musical experience to organize rhythmic and tonal information, while Smith (1985) concluded that musicians tend to group rhythms in meter while nonmusicians do not.

Most beginning band methods present rhythm from the aspect of theory before practice. Students learn the names and arithmetic values of notes before they have an aural understanding of the rhythms. Presentation generally begins with the whole note, followed by the shorter note values in a note to note approach. The note values used in the RPI are very similar to those encountered in beginning band methods; however, the rhythm patterns presented in the RPI are more complex than those of the band methods.

As shown in the results there was not a significant difference between the recognition scores of students in grade six and those in grades seven through ten. (See table 4) A review of the data indicates that student recognition of patterns increased as both the pattern length and the rate of presentation decreased. Scores on patterns performed at 60 MM ranged from 72 to 93. (See Appendix C) Seventy percent or above of the students were able to recognize patterns at this tempo regardless of the length of the pattern. It seems that with a slower rate of presentation students are able to encode the patterns or possibly regroup the longer patterns into smaller chunks. This supports the findings of Dowling (1973) and Miller (1956) and may be an important consideration when teaching rhythm patterns. If patterns are presented at a slower rate, then students may be better able to process them.

With regard to pattern length, it was found that scores increased as the number of sound events decreased. Scores on items with nine or fewer sound events ranged from 70% to 97%. This supports Miller's (1956) 'channel capacity' or 'limited processing' theory which states that the

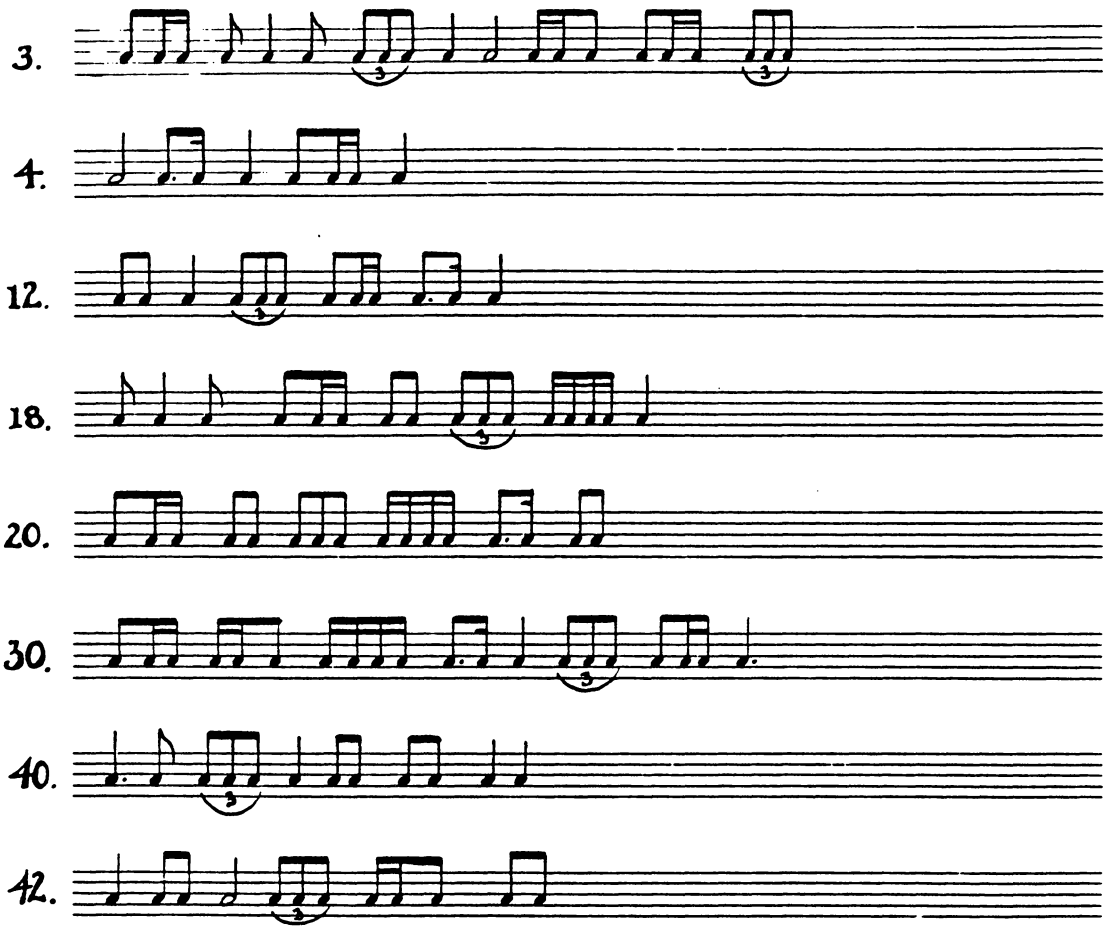
human mind has the capacity to process approximately seven bits or chunks of information; and that the capacity can be increased by recoding or regrouping items. To apply this information to teaching, it appears that students can recognize patterns of nine notes in length which is a factor to be considered when teaching students new music. Also, through metric grouping, students may be able to increase the number of sound events processed. If this is correct, then students at the beginning level could learn longer patterns than those presented in the beginning band method books. The patterns presented in the revised RPI were nonmetric and unaccented in order to control for grouping. If students can recognize patterns without meter one may assume that adding structure to the patterns would increase recognition. As indicated by Deutsch (1980), structured patterns are recalled more readily than unstructured patterns.

Common factors in the eight most missed items on the test were that each item consisted of twelve or more sound events; each item was four or five seconds in length; and that the tempo of each item was 80 MM to 120 MM. The only exception to this was item 4 which was eight notes in length and was played at the metronome marking of 80. (See table 7) Comparing this pattern with others on the test (Appendix B), the one difference that occurs is that the pattern begins with a half note. Since meter or accents were not given, beginning the pattern with a long note value at a slower tempo may have made it difficult for one to establish a tempo or beat.

The plateau effect discussed by Petzold (1963) with elementary students was also found to apply to the scores of older students in the re-

Table 7. Most Missed Rhythm Patterns

Item No.



cognition of rhythm patterns. The differences in grades six through twelve were at a five year interval as compared to the three year interval of the elementary students. One questions why this effect takes place in that it seems that with instruction students would show a greater improvement between grade levels on their rhythm recognition. To answer this it may be necessary to look at the techniques used in teaching older students and to look at how the students are grouped. Emphasis may be placed on performance and the learning of rhythms may be limited to what is encountered in the music being studied. This can be a limiting factor for many students in that the difficulty level of music studied may depend on the instrumentation of the individual school organization. The less difficult the music, the fewer new rhythm patterns encountered. In addition many teachers do not have a structured or sequential method of teaching students after they have completed the beginning and intermediate method books. Much of what is learned is through sheet music study and not through a planned curriculum. Also, rhythm at this level may be taught in context with melody rather than as a single unit. As shown in Sink's (1983) study, the simultaneous presentation of rhythm and melody may result in reduced attention to absolute rhythm structure. In addition, the multilevel grouping of high school students may be a factor which affects the rate at which students progress in rhythm understanding. All of these may be factors in why there are no significant differences between student's scores through grade eleven. Perhaps the differences at the high school level may be a result of repetition rather than structured teaching. As stated by Gordon (1984, p. 101) "music literacy

is developed in a cyclical fashion, with each encounter of the same rhythm it should take on more meaning and thus become easier for the student." More research is needed to answer these questions concerning the methods and techniques used in the teaching of rhythm.

SUMMARY

This research investigated the factors of pattern length in number of sound events, pattern length in seconds, and rate of presentation to see if they influenced student recognition of rhythm patterns. In addition, scores for students in grades six through twelve were compared at each grade level and scores of band students were compared with nonmusic students. Data for the study showed that all the factors affected student recognition with length in number of sound events and length in seconds being highly correlated. This is a valuable study in that it was done in a music education environment and that the population tested included students in actual public school situations. Due to these conditions, this is an important contribution to the field of music cognition.

Recommendations for future research in this area include further investigation of the ability of young students to comprehend rhythm patterns. Music educators need to know if young students can recognize and perform more complex rhythm patterns if they are taught rhythm through a sequence of patterns rather than a note to note approach. If they can recognize more complex patterns can they actually perform these patterns? Is there a better understanding of rhythm if it is taught on a single tone

as opposed to in a melodic context? Investigation of the plateau effect of high school students needs to be considered. Is the plateau effect of scores of elementary students also a common phenomenon of high school students? If so, what is the cause? Does the multilevel grouping of instrumental students at the high school level have an effect on their improvement rate? In addressing these issues, more research needs to be done as to the methods of instruction used in teaching rhythm. Factors to be considered are: techniques used in teaching rhythm, amount of time spent on rhythm instruction, complexity and length of patterns taught, and the ability of students to transfer learning of rhythm patterns to or from a melodic context. It is evident that young students can perceive and recognize complex patterns as well as older students, yet most of the instrumental methods fail to challenge the beginning student with rhythm pattern instruction.

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APPENDIX A

RHYTHM PATTERN IDENTIFICATION LETTERS, TEST INFORMATION, AND FORMS

April 29, 1987

Dear Colleague,

I am working on my dissertation at VPI. My topic is the "Influences of Tempo, Pattern Length, and Grade on Recognition of Rhythm Patterns". In order to obtain the necessary information for my topic I have devised a Rhythm Performance Identification Test. The purpose of the test is to test students' ability to recognize rhythm patterns of different lengths. The test consists of 48 pairs of rhythm patterns which are performed on a single tone. The students are to indicate if the pairs of patterns are the same or different. The length of the test is approximately 15 minutes. All directions will be included on the cassette tape that contains the test.

I would appreciate your help in collecting data. I would like you to administer the test to all of your band students in grades 6-12. Enclosed is a packet with the test directions, tape, and answer sheets. Again I appreciate any help you can give me.

Sincerely,

Diana Love

DIRECTIONS FOR THE
RHYTHM PATTERN IDENTIFICATION TEST

ENCLOSED YOU WILL FIND THE FOLLOWING:

1. Student Information Sheet
2. Opscan Answer Sheets
3. Cassette Test Tape (test on side A or 1)
4. Return Addressed-Stamped Envelope

TO GIVE THE TEST YOU NEED:

1. Cassette Tape Player (PLEASE ATTEMPT TO USE QUALITY SOUND REPRODUCTION EQUIPMENT)
2. Students need number 2 pencils to fill in the answer sheets.

DIRECTIONS FOR GIVING THE TEST:

1. Have students complete the Student Information Form
2. ANSWER SHEET: Fill out as follows:

   ID NUMBER _____
   (use the last 4 digits of phone no.)

   NAME _____
   school name (please print)

   COURSE _____
   write in class and period (ex. Beginning/7)

   DATE _____ GROUP _____
   put GRADE LEVEL

Once students have completed this information play the cassette tape. The entire tape takes approximately 15 minutes to play. There are two examples at the beginning of the tape. These should be answered on the student information form. The examples are followed by the 48 test patterns. PLAY THE TAPE ONE TIME ONLY.

PLEASE RETURN THE COMPLETED TESTS AND FORMS IN THE ENCLOSED ENVELOPE BY JUNE 1, 1987. Again, thank you for your help in this project. You will be sent a summary of the results of this study upon its completion.

RPI TEST INFORMATION

PLEASE COMPLETE THE FOLLOWING INFORMATION CONCERNING THE ADMINISTRATION OF THE RHYTHM PATTERN IDENTIFICATION TEST.

SCHOOL _____

CLASSES GIVEN TEST AND TIME OF DAY:

	CLASS	TIME
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____

WHAT WAS THE MAKE OF THE TAPE RECORDER USED?

_____

WERE THERE ANY PROBLEMS WITH PLAYBACK EQUIPMENT OR THE TAPE?

_____ YES _____ NO

(IF YES WHAT WERE THE PROBLEMS?_____

_____)

ARE THERE ANY OTHER FACTORS WHICH MAY HAVE AFFECTED STUDENT TESTING (Ex. day of week, time of day, etc.)?

_____

_____

_____

_____

STUDENT INFORMATION FORM
RPI TEST

Music Class_____ Nonmusic Class_____ (check one)

ID NUMBER_____
(last 4 numbers of phone no.)

SCHOOL_____

GRADE_____ AGE_____

MALE___ FEMALE___ (check one)

ENROLLED IN BAND___YES ___NO

BAND INSTRUMENT YOU PLAY
_____

NO. YRS. IN CHORUS
_____(JR. HI. 6-8)
_____(SR. HI. 9-12)

NO. YRS. IN BAND
_____(JR. HI. 6-8)
_____(SR. HI. 9-12)

NO. YRS. PLAYED INSTR. _____

PRIVATE LESSONS ON BAND INSTRUMENT _____YES _____NO

NO. YRS. PRIVATE LESSONS ON BAND INSTRUMENT _____

Do You Play Another Instrument
____ YES ____ NO (if yes what instr. _____)

Private Lessons on this instr.
____ YES ____ NO (if yes how long _____)

RHYTHM PERFORMANCE IDEN. TEST EXAMPLES:

RHYTHM PATTERN IDENTIFICATION TEST
DIRECTIONS

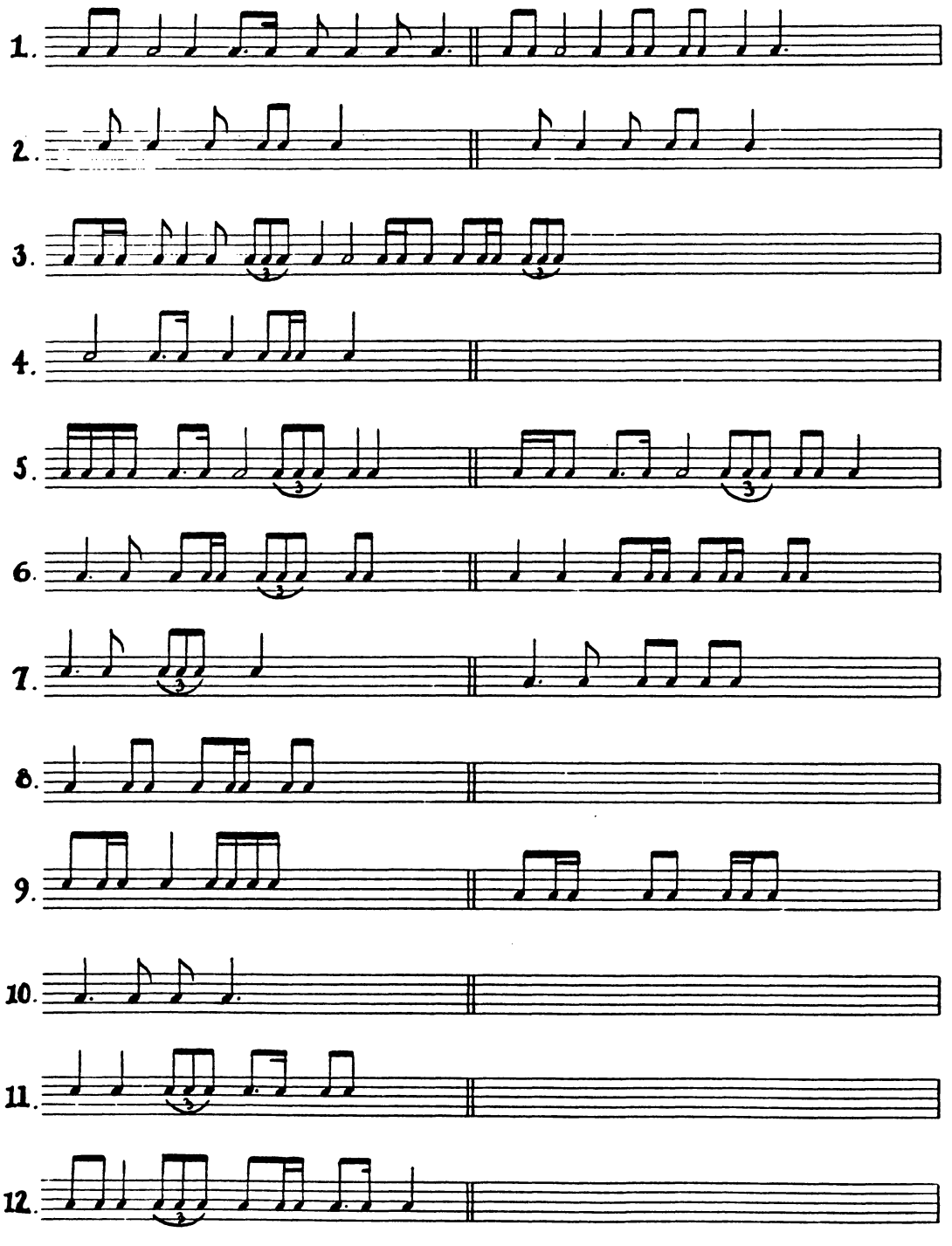
The following test consists of 48 pairs of rhythm patterns. As you hear each pair of rhythm patterns you are to indicate whether the patterns are the same or different. Fill in no. 1 for SAME and no. 2 for DIFFERENT. EACH SELECTION WILL BE PLAYED ONLY ONCE SO LISTEN CAREFULLY.

At the beginning you will be given two examples. The answers for these should be written on the student information form. Example number 1. _____ Example number 2. FOR EXAMPLE NO. ONE THE PATTERNS WERE THE SAME YOU SHOULD HAVE FILLED IN 1; FOR EXAMPLE NO. 2 THE PATTERNS WERE DIFFERENT YOU SHOULD HAVE FILLED IN 2.

WE ARE NOT READY TO BEGIN THE TEST. LISTEN CAREFULLY

APPENDIX B

RPI TEST RHYTHMS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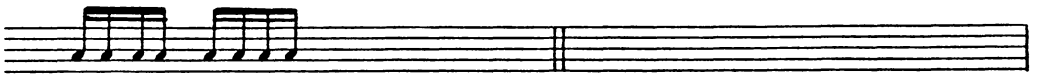

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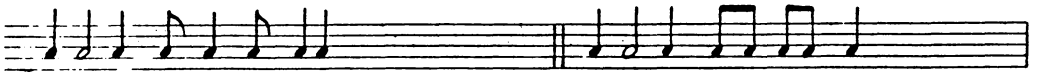

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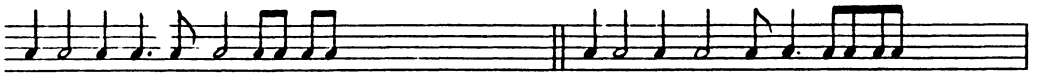

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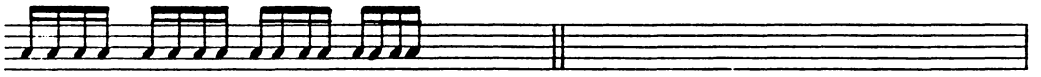

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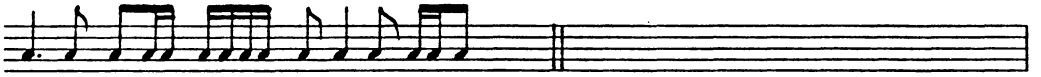

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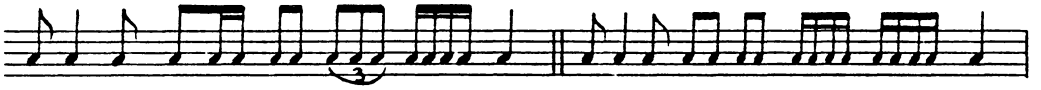

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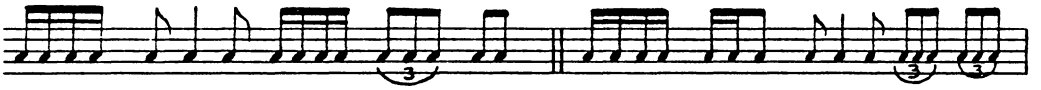

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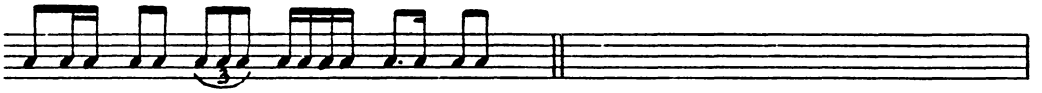

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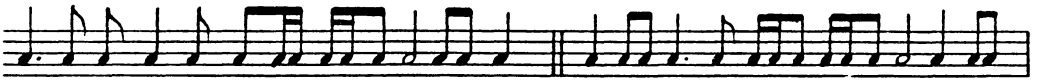

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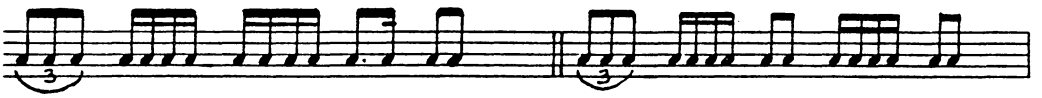

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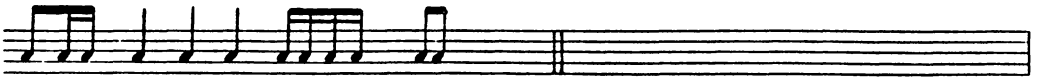

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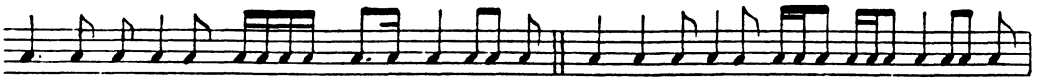

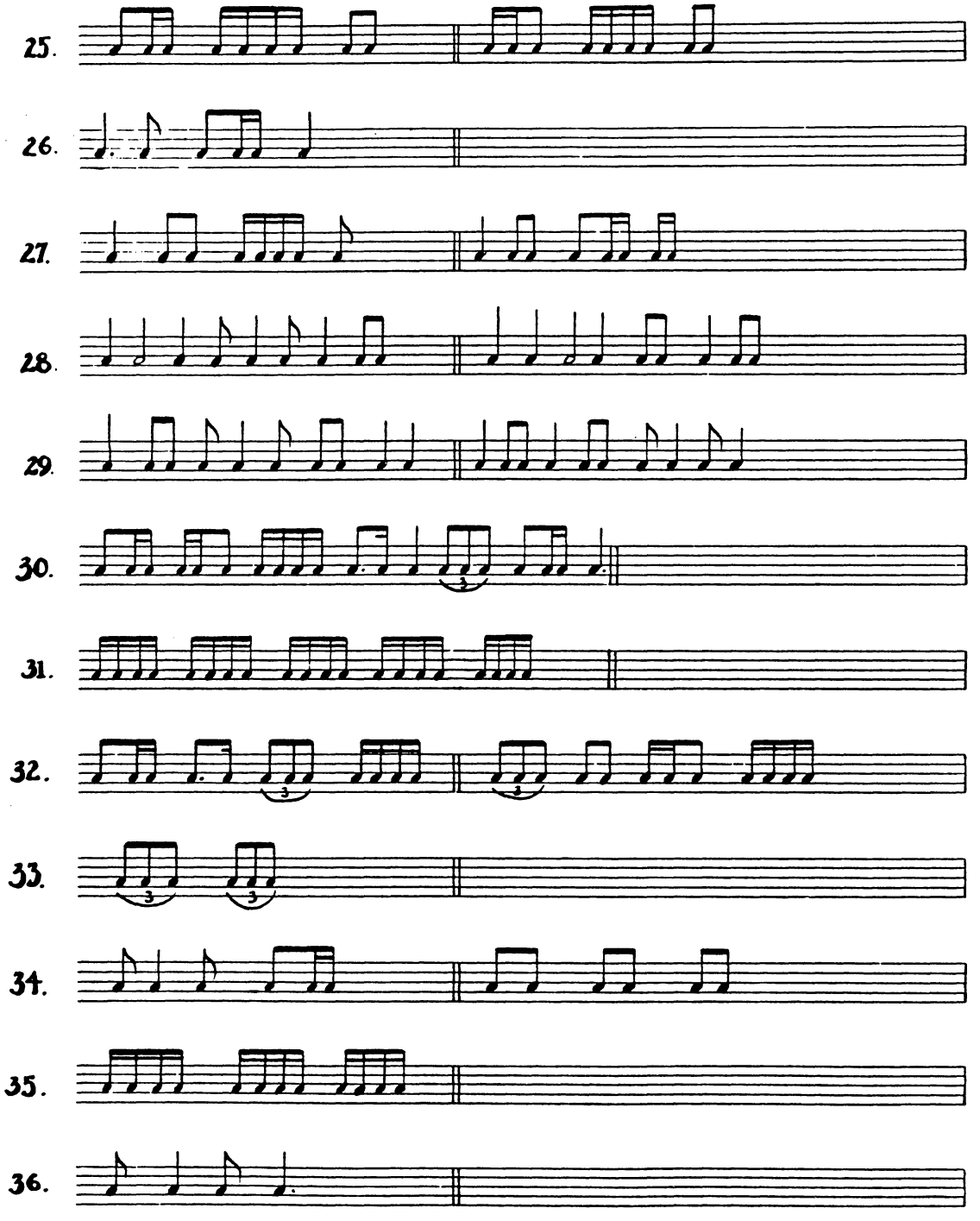
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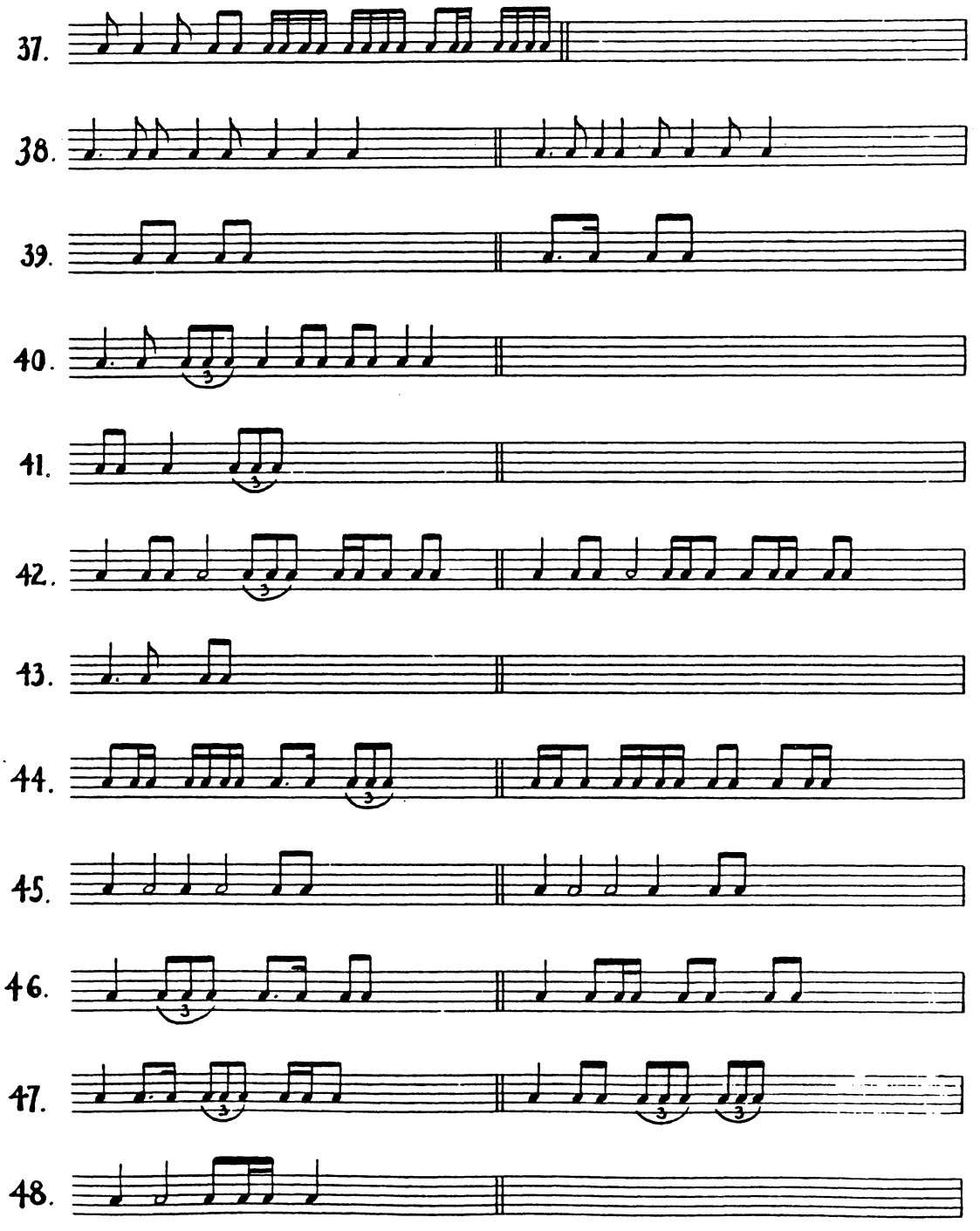
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APPENDIX C

GRADE LEVEL SCORES, MEANS, AND STANDARD DEVIATIONS

GRADE LEVEL SCORES, MEANS, AND STANDARD DEVIATIONS

ITEM	SOUND	LENGTH	TEMPO	MEAN	SD	SC6	SC7	SC8	SC9	SC10	SC11	SC12
3.	20	5	120	56.00	5.93	55.75	54.50	52.25	47.75	60.00	55.33	66.50
30.	20	5	100	51.34	6.88	50.00	52.75	44.75	49.25	50.33	48.33	64.00
31.	20	5	60	80.70	3.04	81.00	78.00	82.75	77.50	85.67	78.00	82.00
37.	20	5	80	55.70	2.72	51.25	56.50	59.75	53.25	56.33	56.33	56.50
12.	12	4	80	44.17	1.78	43.50	41.75	42.00	46.00	45.00	46.00	45.00
17.	16	4	60	83.25	5.98	79.50	72.00	82.75	86.00	85.67	90.33	86.50
18.	16	4	120	54.64	9.49	42.25	43.50	50.50	57.75	63.67	58.33	66.50
20.	16	4	80	50.42	5.66	49.50	44.50	49.75	45.50	54.33	48.33	61.00
35.	12	3	60	85.17	6.93	84.00	75.00	81.00	84.50	87.33	92.67	95.50
17.	15	5	80	55.54	2.63	58.50	53.00	59.00	56.75	53.00	53.00	55.50
21.	15	5	120	71.52	12.77	49.00	61.00	67.25	80.25	80.00	81.67	81.50
22.	15	5	60	72.22	8.44	57.00	70.00	73.25	69.00	73.00	81.33	82.00
24.	15	5	100	75.24	7.79	64.75	68.25	75.50	72.00	76.00	84.67	85.50
5.	12	3	120	75.90	5.56	66.50	70.00	78.00	77.50	82.33	78.00	79.00
19.	16	3	100	83.71	8.96	69.50	76.25	82.00	83.75	87.33	92.67	95.00
23.	12	3	100	82.94	4.69	81.00	83.25	82.00	87.50	81.67	90.00	75.50
32.	12	3	60	86.25	6.75	74.25	84.00	83.50	87.00	89.33	89.67	96.00
40.	12	3	120	50.65	3.71	50.75	53.75	53.25	51.50	53.00	49.33	43.00
42.	12	4	100	56.08	7.19	49.25	45.25	55.00	56.25	58.00	63.33	65.50
44.	12	3	80	91.21	5.94	81.75	88.00	88.50	89.25	96.33	97.67	97.00
1.	10	5	100	85.06	6.47	80.00	76.25	88.00	89.00	79.00	92.67	90.50
6.	10	5	60	78.15	4.60	72.50	75.00	75.25	83.00	80.33	85.00	76.00
15.	10	5	120	56.33	4.53	50.25	55.50	61.00	61.75	51.67	54.67	59.50
29.	10	5	80	59.14	8.04	49.75	48.25	56.00	61.50	65.33	63.67	69.50
11.	9	3	100	67.05	6.31	62.25	66.50	72.75	68.25	60.00	59.00	76.50
25.	9	3	60	87.24	5.33	78.00	84.75	87.50	84.25	91.67	92.00	92.50
47.	9	3	80	79.58	6.14	77.50	74.75	76.75	73.75	86.33	90.00	78.00
4.	8	4	80	35.75	3.49	39.75	35.75	39.50	36.25	31.33	36.67	31.00
8.	8	4	60	77.00	3.36	79.00	73.25	74.50	80.25	82.00	75.00	75.00
9.	8	2	80	76.52	10.42	67.50	75.00	81.00	82.00	77.33	80.33	92.50
13.	8	2	60	89.46	2.61	87.75	88.50	89.25	85.75	90.00	91.00	94.00
14.	8	4	120	86.79	6.02	82.50	78.25	83.50	89.50	85.67	93.67	94.50
27.	8	2	100	84.70	7.88	82.25	83.50	69.75	85.75	85.67	92.00	94.00
28.	9	3	120	84.15	7.27	77.50	76.50	80.25	80.00	89.00	91.33	94.50
33.	6	2	60	80.25	14.06	80.50	83.00	83.75	90.25	84.67	90.33	49.50
38.	8	4	100	77.28	6.14	65.50	73.50	75.00	80.00	82.00	84.00	81.00
46.	8	2	120	80.28	5.23	71.25	76.25	80.50	82.00	81.33	87.67	83.00
2.	6	2	120	85.86	6.75	79.75	78.00	87.00	86.00	85.00	86.33	99.00
7.	6	2	100	79.96	5.70	77.75	74.75	77.00	75.25	81.00	83.00	91.00
26.	6	3	80	77.30	6.46	69.00	72.75	74.50	73.25	85.33	84.00	82.50
34.	6	2	80	93.57	2.48	93.00	91.50	93.00	92.00	92.67	97.33	95.50
41.	6	3	60	74.11	4.38	67.50	69.00	75.50	76.25	78.33	78.67	73.50
45.	6	3	120	84.38	4.40	76.75	81.50	84.25	83.50	87.67	90.00	87.00
43.	6	3	100	83.23	3.39	76.00	83.00	85.00	83.25	86.33	85.00	84.00
10.	4	2	100	86.28	3.39	82.24	86.00	85.75	82.50	91.67	89.33	86.50
36.	4	2	120	93.65	2.05	92.00	91.50	91.50	93.75	95.67	94.67	96.50
39.	4	2	60	93.61	3.65	93.00	88.75	94.75	88.75	95.33	97.67	97.00
43.	4	2	80	87.06	4.89	89.75	88.25	88.25	84.00	89.33	92.33	77.50
Number of Students=				2006		374	448	482	347	200	119	67

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The three page vita has been removed from the scanned document. Page 3 of 3