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# To develop and validate an objective measure of locomotor response to auditory rhythmic stimuli

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BOSTON UNIVERSITY  
SCHOOL OF EDUCATION

Dissertation

TO DEVELOP AND VALIDATE AN OBJECTIVE  
MEASURE OF LOCOMOTOR RESPONSE TO  
AUDITORY RHYTHMIC STIMULI

Submitted by

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(B.S. in Ed., Tufts College, 1943)  
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In Partial Fulfillment of Requirements for  
the Degree of Doctor of Education

1957

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1958

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CHAPTER I  
INTRODUCTION

Rhythm in dance and music is important, and has been treated and discussed in various ways. The fact that individuals differ in their ability to respond easily and accurately to rhythmic stimuli requires no substantiation nor elaboration. Good rhythm has seemed to be a quality which happens to exist in some beings, and not in others. The difference is a matter of general recognition. In physical education classes the instructor knows that he will have to deal with some to whom "rhythm" is a thing unknown. In groups of recruits the Army found the inevitable number who were unable to keep in step. In dancing classes for beginners, the teacher knows there will be some for whom the musical rhythms mean little.

Instinctive response to music may occur very early in the life of a child. The child may react to musical stimulation by clapping, swaying, or performing little natural "dance" steps. It is interesting to note that while it appears that the child is cognizant of music or of a rhythm and responds to that sound, he is not always able to respond in like rhythm. Many proud parents enroll their young offspring in schools of dance education due to rhythmic responses to musical stimulation

which they have noted in the child. In many cases the responses are inadequate, and the child is considered to have "poor" rhythm.

For many years, rhythmic response was not measured. When measurement did occur, it was on a subjective basis. "Good" and "poor" are quality terms and depend upon subjective judgment. This subjective classification of individuals as "good" or "poor" is based on observation and reflects only the opinions of the observer. It is the result of the "trial and error" method and not of a scientifically established technique.

Although objective measurement of the sensory response to rhythm has been rather successful, there is no evidence that the ability to score successfully on a sensory test indicates that the subject would perform as well on a locomotor response measure.

Of the objective measures available for motor response, none demand a locomotor response which is an essential factor in dance.

There is a need today for a locomotor measure to take much of the guesswork out of classifying individuals. The comparisons of groups with expected or presumably high levels of rhythmic response with persons of general population may serve to provide some practical data.

Do some individuals who seem to possess rhythm really have "good" rhythm to a measurable degree over those who are not

necessarily expected to have it? Is it really a quality that occurs in greater extent in some beings than it does in others? These are some of the questions that motivated the present study.

### 1. Statement of the Problem

The purpose of this study is to construct an instrument to measure objectively locomotor response to rhythmic auditory stimuli. This purpose will be considered accomplished if the instrument distinguishes between members of the study groups; if, as evidence of its validity the results obtained from measuring groups of untrained, trained amateurs, and professional dancers reflect the obvious difference in the rhythmic skill of these groups.

### 2. Justification of the Problem

At the present time, no objective measure of locomotor response to rhythmic stimuli exists.

Although there are sensory tests which measure discrimination, rather than ability, existing motor tests of rhythm are inadequate because they fail to measure locomotor response. As locomotor response is of paramount importance in the field of dance, this instrument will attempt to meet the need.

### 3. Scope of the Problem

The possibility of measuring objective rhythmic response to auditory stimuli will be considered to have been explored

if, from the research and experimentation, there is evolved a valid and reliable test of locomotor response. The validity and reliability will be determined by the results achieved by definitely specified groups.

The study will include first, a search of current literature on the subject of the measurement of rhythm as well as on the place of rhythm in dance. Secondly, it will require the development of a measure, including a technique for its use, of locomotor response. The third step will involve administering the locomotor response measure to individuals within control and experimental groups. The groups will include members of the general college population (control group), and trained amateur and professional dancers (experimental groups).

A sensory test<sup>1/</sup> will be administered to the control and experimental groups. The sensory test will require a written response.

The final step will be concerned with the statistical analysis of the test results. The analysis will involve comparisons among the three groups, of their scores on the experimental instrument and the results of the sensory rhythm discrimination tests administered to the groups.

For the purposes of this study, using the analysis of variance technique, a one percent level of confidence will be

<sup>1/</sup>Jacob Kwalwasser and Peter Dykema, Music Tests, Victor Record 304; 12-inch Discs, 78 r. p. m., Carl Fischer, Inc., New York, 1930.

considered significant for the results on the experimental instrument. The sensory test results will be correlated with scores received on the instrument by means of the Pearson Product Moment Correlation Coefficient.

#### 4. Definition of Terms

Many terms used in this study may have different meaning and interpretations. For the purpose of the study the terms will be defined as follows:

Auditory stimuli.-- Anything pertaining to hearing that incites the organism to activity; a signal received through the sense of hearing which motivates a reaction pattern.

In this study, auditory stimuli will be represented by the rhythmic patterns played on a piano, and recorded on magnetic tape for constant presentation.

Response.-- Locomotor response is any act or reaction of an organism involving movement or change from place to place, resulting from stimulation. The stimulus-response pattern will consist of one measure of rhythmic beats, to which the subject responds by locomotor activity.

Written response is the answer recorded by the subject to the stimulus of patterns presented in the sensory tests.

Rhythm.-- The replication by locomotor response of specific auditory stimuli.



Rhythmic beats are particular metrical effects performed in sequence on a piano. These effects will vary in time, tempo, and note value.

Time is the arrangement of beats or units within a measure. In this study there will be two, three, or four elements of time in each measure.

Tempo is the rate of movement or rapidity of the units within a measure.

Note value is the symbol which represents the number of beats any note possesses. A whole note will have four counts, a half note two counts, and so on.

Even rhythms are those units in a measure which are alike; all of the elements in an even rhythm measure have the same value.

Uneven rhythms involve the variation of units within a measure. The elements are unlike.

A continuing rhythmic pattern involves the repetition of a measure several times without pause between measures.

## CHAPTER II

### REVIEW OF LITERATURE

Rhythm as a powerful force in dance and music is recognized and noted by all. A review of the literature in the field of rhythm reveals that the subject is consistently treated from two distinct points of view: the artistic, and the practical.

Many writers of literature on dance and music treat the subject of rhythm in its relationship to the universe as a whole. They are concerned with the philosophy of rhythm, its universality, and its manifestation in the world of nature and works of arts.

Rhythm as an essential element in all art forms has received the greater amount of attention from students and writers in the field. Indeed, they are quite lyrical on the subject of rhythm in the seasons of the year, in the ebb and flow of the tide, in the waft of breezes on the wheat field. More concretely dealt with is rhythm in architecture, in fine arts, and literature. Valuable though these contributions are, they are not pertinent to this study concerned, as it is, with the capacity of an individual to respond accurately to rhythmic stimuli.

What has a more direct bearing on the present subject is the literature on the nature of the response of the individual to rhythmic stimuli and the existing instruments designed to measure them.

### 1. Rhythm and the Individual

The nature of rhythm.-- Seashore<sup>1/</sup> defines rhythm as ".... an instinctive disposition to group recurrent sense impressions vividly and with precision, mainly by time or intensity, or both, in such a way as to derive pleasure and efficiency through the grouping." He enlarges that statement by asserting, "We cannot have adequate perception of rhythm without motor setting. The bearing of this instinctive motor tendency of rhythm lies in the fact that with the motor instinct goes an instinct to be in a receptive attitude for the perception of such rhythms."<sup>2/</sup>

Kinesthesia and rhythm.-- Ruckmick<sup>3/</sup> feels the importance of kinesthesia in rhythm as he reports, "Basic rhythm is a specialized rhythmic kinesthetic memory which is formed of

<sup>1/</sup>Carl E. Seashore, Psychology of Music, McGraw-Hill Book C., Inc., New York, 1938, p. 139.

<sup>2/</sup>Ibid., p. 143.

<sup>3/</sup>Christian Ruckmick, "Role of Kinesthesia in Perception of Rhythm," American Journal of Psychology, (April, 1924) 24: pp. 35.

innumerable instances of the retention of a muscle-set long enough to compare it with a repetition." This position is supported by, "Rhythm is one of the foundation structures in all motor skills."<sup>1/</sup> Further affirmation comes from Flagg who writes, "Rhythm is first and last a physical experience."<sup>2/</sup> Isaacs records a concurring vote with, "Rhythm is the experience arising from the periodic pendular reflex response of characteristic parts of the body to objective stimulation."<sup>3/</sup> Another authority states, "The rhythm of movement in the human organism is kinesthetically perceived and governed."<sup>4/</sup> "In the last analysis rhythm is a muscular response to that auditory stimulus and finds its natural expression in muscular movement of some kind or other."<sup>5/</sup> Seashore again states, "Rhythm is never rhythm unless one feels that he himself is acting to it."<sup>6/</sup>

<sup>1/</sup>Carl E. Seashore, op. cit., p. 148.

<sup>2/</sup>Marion Flagg, Musical Learning, C. C. Birchard Co., Boston, 1949, p. 67.

<sup>3/</sup>E. Isaacs, "Nature of Rhythmic Experiences." Psychological Review, 1920, pp. 270-300.

<sup>4/</sup>Elizabeth R. Hayes, Dance Composition and Production for High Schools and Colleges. The Ronald Press Co., New York, 1955, p. 55.

<sup>5/</sup>John Redfield, Music: A Science and an Art, Alfred Knopf Co., New York, 1941, p. 212.

<sup>6/</sup>Carl E. Seashore, Psychology of Music, McGraw-Hill Book Co., Inc., New York, 1938, p. 142.

The basis of rhythm.-- One author <sup>1/</sup> feels that there are five factors basic to a sense of rhythm. These are: a sense of time and intensity, auditory and motor imagery, and a motor impulse for rhythm. Another work <sup>2/</sup> reports that there are many who feel that there is an inborn tendency to express rhythm by means of rhythmic repetition. "Within each individual.... there is a certain quality, possessed in varying degrees by different individuals, which allows him to respond to rhythmic stimuli."<sup>3/</sup>

Writers, it appears, agree that rhythm is an innate characteristic which individuals possess, and to which they may respond by motor reaction.

## 2. Rhythm and the Dance

Historical evidence discloses that music or rhythmic sound has always been associated with dance. Sound or music has served as both a stimulus for dance and an accompaniment to it. <sup>4/</sup> Sutherland <sup>5/</sup> suggests that to make music doubly

<sup>1/</sup>Carl E. Seashore, The Psychology of Musical Talent, Silver Burdett and Co., New York, 1919, p. 117.

<sup>2/</sup>Bernard Mason and Elmer Mitchell, The Theory of Play, A. S. Barnes and Co., New York, 1948, p. 14.

<sup>3/</sup>Betty Lynd Thompson, Fundamentals of Dance and Rhythm, A. S. Barnes & Co., New York, 1953. p. 7.

<sup>4/</sup>Elizabeth R. Hayes, Op. cit., p. 94.

<sup>5/</sup>Eileen Sutherland, "Accompaniment for the Dance," unpublished paper read at the meeting of the Boston Dance Council, December 12, 1943.

interesting, it should be combined with dance. A knowledge of music is important for the intelligent dancer, for through such a combination one can enhance the fine feel that one gets from rhythmic movement with a sure knowledge of rhythmic structure.

Radis<sup>1/</sup> reports, "The rhythm of dance is not subordinate to other ends, but is an essential aspect of the structurization of movement." Seashore<sup>2/</sup> again cites rhythm as one of the foundation structures in all motor skills.

Thus it is seen that there exists an indissoluble relationship of rhythm and the physical being. Rhythm is also an essential element in dance. This is further indication of the desirability of a measure to make an objective tally of individual rhythmic ability.

### 3. Rhythm and Measurement

Current rhythm tests can be divided into types according to the overt behavior their authors choose to accept as evidence.

Motor Tests.--Stupp<sup>3/</sup> performed an experiment which used the subjective rating of an instructor's grade as measurement of rhythmic motor ability. She expressed dissatisfaction with such means by stating, "The only means of measuring artistic quality of this sort is by the teacher's estimate, and this

<sup>1/</sup>Ruth A. Radis, Modern Dance for the Youth of America, A. S. Barnes and Co., New York, 1944, pp. 167--168.

<sup>2/</sup>Carl E. Seashore, Psychology of Music, op. cit., p. 148.

<sup>3/</sup>Lillian L. Stupp, A Correlation of Musical Ability and Dancing Ability, M. A. Thesis, University of Wisconsin, 1922.

proves to be scientifically unreliable." In her thesis, Stupp stated, "The auditory perception, the appreciation of music, may rate high, yet one's motor power to express such by means of rhythmical bodily movement may be lacking, or at least undeveloped."

Heinlein<sup>1/</sup> also found subjective observation to be inaccurate. "In regard to the rhythmic capacities of children, results obtained through exact measurement do not agree with judgment affected through simple observation." He affixed a small stirrup on one shoe, and as the subject walked to music on a track, a person of "excellent" rhythm would do the same in another room. A record was made of these two results and comparisons made.

Baldwin and Stecher<sup>2/</sup> in an experiment with pre-school children found that children tended to change from the offered rhythm to some rhythm of their own when clapping wooden blocks together after an original rhythm set by metronome.

Some efforts have been made to obtain objective judgment

1/Christian P. Heinlein, "A New Method of Studying the Rhythmic Responses of Children together with an evaluation of the Method of Simple Observation, Journal of Genetic Psychology, June, 1929) 26:2, pp. 205-229.

2/B. T. Baldwin and L. I. Stecher, The Psychology of the Pre-School Child, D. Appleton and Co., New York, 1924, pp. 141--145.

of motor rhythm. Shambaugh<sup>1/</sup> made an individual stand on treadles, holding taut cords in his hands. The subject would execute a certain repetition of folk dance steps, the exact time for the series being known; scoring was based on the time and the correct coordination of arms and legs.

Another study made by stop-watch timing of certain steps and patterns, in comparison with professional instructors' actions and judgment was performed by Ashton.<sup>2/</sup>

Buck<sup>3/</sup> had a two-part experiment. The first phase required the subject to listen to tom-tom beats, and draw the note value of the sounds heard. The other part involved finger tapping of rhythmic patterns given by auditory stimuli. The subject was scored right if the proportions of the phrases were correct, even though the time was incorrect.

Seashore<sup>4/</sup> performed an experiment in which a turntable was used. The subject was required to tap with a stylus as rapidly as possible within a specific time interval. The greater number of taps, the better the score.

1/Mary Effie Shambaugh, The Objective Measurement of Success in the Teaching of Folk Dancing to University Women, Ph. D. Thesis, University of California, 1935.

2/Dudley Ashton, A Gross Motor Rhythm Test, Master's Thesis, State University of Iowa, 1952.

3/Nadine Buck, "A Comparison of Two Methods of Testing Response to Auditory Rhythms," Research Quarterly, October, 1936.

4/Carl E. Seashore, The Psychology of Musical Talent, op. cit., p. 88.



Sensory Tests.-- Certain paper and pencil tests of musical ability have been made. The leading exponents of these are Seashore<sup>1/</sup> and Kwalwasser-Dykema.<sup>2/</sup> Both of these contain paired patterns on phonograph records, and the subjects are required to choose the correct answer. Whistler and Thorpe<sup>3/</sup> also have produced a sensory test involving written responses, but this is not recorded.

Other studies.-- Certain other studies pertaining to rhythm have been made. Kwalwasser<sup>4/</sup> found that rhythm was not improved by training. Klauer<sup>5/</sup> also studied the problem of practice and training and found that her study "...shows unequivocally that training does not improve one's rhythmic discrimination."

Kwalwasser<sup>6/</sup> reports that age is not a factor in rhythmic abilities. In a series of studies he determined that there is a greater difference within than between age groups. He

<sup>1/</sup>Carl E. Seashore, Psychology of Music, op. cit., p. 139.

<sup>2/</sup>Jacob Kwalwasser and Peter W. Dykema, loc. cit.

<sup>3/</sup>Harvey S. Whistler and Louis P. Thorpe, Musical Aptitude Test, California Test Bureau, California, 1950.

<sup>4/</sup>Jacob Kwalwasser, Tests and Measurements in Music, C. C. Birchard and Co., Boston, 1928, p. 3.

<sup>5/</sup>Neomi J. Klauer, The Effect of Training upon Rhythmic Discrimination in Intermediate Grades, Thesis, State University of Iowa Library, 1924.

<sup>6/</sup>Jacob Kwalwasser, Exploring the Musical Mind, Coleman-Ross Co., Inc., New York, 1955, p. 71.

reports that older children meet the testing situation better as they "...follow directions more readily, concentrate longer, resist distractions, and are generally more at ease than younger children."<sup>1/</sup>

Hollingworth<sup>2/</sup> found that intellectually superior children were not superior in music sensitivity. Another writer<sup>3/</sup> also found no relationship between I. Q. and music.

#### 4. Need for Further Research

Among the various writers there is one point of unanimity; namely, the need for further study.

Kwalwasser makes a strong case for further study in the area of rhythm. As an example he says, "How impossible it is to judge so simple a trait as pitch discrimination without a properly constructed pitch test!" And, "We need more and better measuring instruments than we now have." Again, "Unaided judgment may be considerably improved by the use of testing paraphernalia."<sup>4/</sup>

<sup>1/</sup>Ibid., p. 34.

<sup>2/</sup>Leta S. Hollingworth, "Musical Sensitivity of Children Who Test above 135 I. Q. (Stanford Binet)," Journal of Educational Psychology (February, 1926) 17:2.

<sup>3/</sup>Charles F. Lehman, "A Study of Musical Style Recognition," Delta State College, Cleveland, Mississippi, Journal of Educational Research, January, 1957.

<sup>4/</sup>Jacob Kwalwasser, op. cit., p. 163.

Redfield<sup>1/</sup> makes a plea for a musical laboratory which would include a department for the study of rhythm. He says, "We need to know as much as possible about rhythm....and the only way to acquire further information is to give it sincere and protracted study." He is of the opinion that the study of rhythm is almost entirely undeveloped.

Further statements provide greater weight for this need. "No test has been developed which is an acceptable measure of motor ability in this (rhythm) field." ...."For the many difficulties which confront the instructor who would measure objectively in the field of dancing and rhythm, the literature offers few aids."<sup>2/</sup>

Seashore<sup>3/ a</sup> acknowledges, "We have no precise measure of the motor impulse, which is the motive power in the perception of rhythm."<sup>4/</sup> Stanton expresses an interest in "...the development of a group of measurements of motor capacities that would supplement the measures of sensory capacities...."

<sup>1/</sup>John Redfield, op. cit., p. 126.

<sup>2/</sup>Ruth B. Glassow and Marion R. Broer, Measuring Achievement in Physical Education, W. B. Saunders Co., Philadelphia, 1949, pp. 211-213.

<sup>3/</sup>Carl E. Seashore, Psychology of Musical Talent, op. cit., p. 125.

<sup>4/</sup>Hazel M. Stanton, Measurement of Musical Talent, University of Iowa Studies, Iowa City, 1935, p. 133.

McCloy and Young<sup>1/</sup> assert, "In the field of dance no practicable tests have been reported."

### 5. Summary

The reports of research and the conclusions of the researchers quoted above indicate that there are four pertinent areas in rhythm investigation.

"Rhythm and the individual" concerns the personal impulse which rhythm draws from each person. It is felt that a sense or feeling for rhythm is an innate characteristic.

Another area covered is concerned with rhythm and the dance. Rhythm is a basic quality in dance. The motor response to music is an essential element in dance.

Certain studies in the field of rhythm have been made. These can be classified under several categories. There are motor tests, sensory tests, and certain other studies made which involve rhythm or rhythmic response.

Probably the most pertinent segment of literature is that in which the need for further study in rhythm is emphasized. The writers show very graphically that there is a dearth of evidence on objective measurement of locomotor response to rhythm at this time, and recommend that much further study and investigation be done in this area.

1/Charles H. McCloy and Norma D. Young, Tests and Measurements in Health and Physical Education, Appleton-Century-Crofts, Inc., New York, 1954, p. 249.

## CHAPTER III

### TECHNIQUES AND PROCEDURES

The reconciliation of the various components of the problem of locomotor rhythmic response is to be found in this section of the study.

It is assumed, for purposes of the study, that differences exist in the locomotor response of individuals, and that these differences can be measured. The review of literature indicates that no such measure exists at the present time. Although there are tests of sensory and motor response, there is no evidence that these traits correlate highly with a measure of locomotor response. It is felt that locomotor response is of great importance in the field of dance; therefore, such a measure would be of value.

This chapter is divided into four sections: (a) the instrument to measure locomotor response (the Rhythmeter); (b) the sensory tests; (c) the study groups; and (d) the summary of a pilot study conducted using the instrument (Rhythmeter).

#### 1. The Instrument to Measure Locomotor Response. (Rhythmeter)

Earlier in the study, rhythm was defined as that replication by locomotor response, of specific auditory

rhythmic stimuli. Logically, therefore, the first step is to prepare the means by which to measure objectively locomotor response.

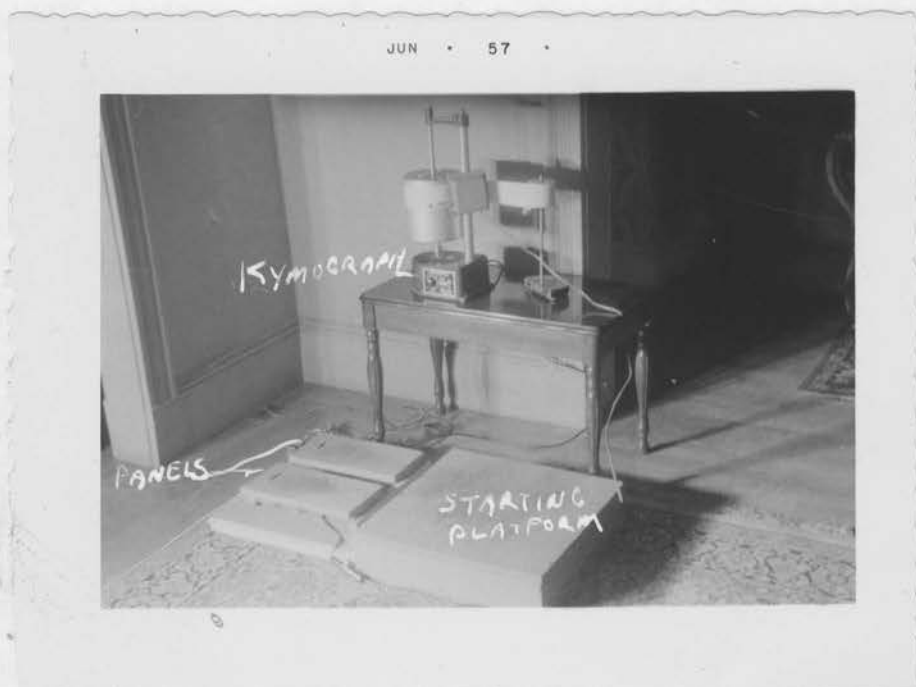


Plate 1. The Instrument to Measure Locomotor Response (Rhythmeter).

The instrument constructed for this study to measure the locomotor response to auditory rhythmic stimuli of individuals is made up of several parts:

The starting box - A platform of the same height as the panels, and so constructed that it fits around the panel section for carrying purposes. The box is 20 inches long, 18 inches wide, and 3 inches high. While in use, the platform is hooked

onto the base of the instrument for stability. It is on the starting box that the individual stands to listen to the instructions, and to which she returns following her response to each item.

Two panels-- the point of contact for the subject--are placed in parallel position, and attached firmly to the rear plane of the instrument. Each is 12 inches long, 6 inches wide, and painted red on the front 4 inches.

Under the front section of each panel is a 2-inch compression type spring with a displacement of 350 pounds per inch. Directly in front of the spring is an electric button switch. As the panels are depressed, a contact on the under surface connects with the switch, thus closing the electrical circuit.

The switches are wired in parallel circuit and are connected with an electromagnet which has a pen-holding arm in contact with the kymograph.

The electricity is supplied from the regular 110 voltage alternating house current, and a chime transformer mounted on the instrument reduces the voltage to 10 volts.

The Kymograph.<sup>1/</sup> --The kymograph is an electrically driven rotating drum, which operates on 115 volt, 60 cycle, A. C. current. The pen-arm attached to the electro-magnet holds a ball-point cartridge firmly against the drum, by means of a small compression spring.

<sup>1/</sup>Bird Kymograph, Phipps & Co., Richmond, Virginia.

The paper on which the pen writes is adding machine tape, which is fed to the kymograph from a spindle. The paper is attached to the drum by scotch tape.

During the course of the presentation, the Kymograph is positioned behind the subject so that it cannot be seen by her.

## 2. The Construction of the Preliminary Test

The test items for the preliminary test were devised using the stimulus-response patterns in measures of  $2/4$ ,  $3/4$ , and  $4/4$  time.

These auditory stimuli were based on variations of the regular beat, and in many cases represent the note values of dances, as tango, rumba, schottische; and locomotor elements as skips, gallops, runs. The 46 beat patterns were produced by drum beats, and recorded on magnetic tape, with the instructions necessary for their presentation. It was felt that drum beats were a basic rhythmic form, and therefore could be used for this preliminary test.



1 2 3 4 5 6

7 8 9 10 11

12 13 14 15 16 17

18 19 20 21 22

23 24 25 26

27 28 29 30

31 32 33 34 35 36

37 38 39 40 41 42

43 44 45 46

Plate 2. List of Rhythmic Patterns  
Used for Pilot Study

3. Summary of Pilot Study  
Conducted Using the Instrument Which  
Measures Locomotor Response  
(Rhythmeter).

A pilot study was conducted using the instrument to measure locomotor response to auditory stimuli, or Rhythmeter, on high-school junior class girls.

Purpose.-- This was to determine whether or not the instrument, or Rhythmeter, measured locomotor response to auditory rhythmic stimuli of individuals. Factors of height and weight, age, and I. Q. were correlated with instrument scores, to determine their effect upon the locomotor response.

Auditory Rhythmic Stimuli.-- These consisted of forty-six stimulus-response patterns, as defined in Chapter I. These patterns were performed by drum beat, and recorded on magnetic tape, with instructions.

Locomotor Response.-- The locomotor response was made on the instrument, or Rhythmeter, and scored by use of a scoring key.

Scoring.-- An individual's score was determined by the number of items right, using the scoring key.

Treatment of Data.-- The scores were correlated with the other test factors by using the Pearson Product Moment Correlation Coefficient method.

Presentation and Analysis of Data.-- The range in scores was 6 to 37. The median score was 17. The mean score was 17.0. The standard deviation was 2.4. There were 42 cases.

Table 1. Reliability Found on Pilot Study

Method	"r"
Split-Half	.82
Spearman-Brown	.86
Test-Retest	.86

Table 2. Correlation of Rhythmeter Scores and Age, I. Q., Height, and Weight.

Factor	"r"
Age	-.168
I. Q.	.165
Height and Weight	.165

An analysis of internal consistency indicated that 24 items were statistically significant, which caused for the rejection of 22 items.

Conclusions.-- The study indicated that individual statistical differences exist in locomotor response to auditory rhythmic stimuli.

Evidence indicates that there was no statistically significant relationship between score on the Rhythmeter and age, between score and I. Q., nor between score and height and weight. Therefore, age, I. Q., height, and weight were not used on the major study.

The results of the study indicated that certain changes should be made in the test. It was found that the test was overlong and tended to induce fatigue and ennui, therefore the test was shortened to include the 15 items which were most significant.

It was felt that some of the patterns required the subject merely to memorize; this did not measure true rhythmic response. For that reason, the continuing rhythm patterns were introduced to be used on the revised test. The continuing rhythm response provides sufficient repetition for the subject to feel the pattern, and then reproduce it. The 15 items were included in the first part of the final test as stimulus-response and in the second part as continuing rhythm patterns.

The drum beats were not satisfactory in that they were not very closely related to dance, as most people experience it. The final test items were played on a piano by a professional pianist, and recorded on magnetic tape.

#### 4. The Objective Measure of Locomotor Response to Auditory Rhythmic Stimuli

The results observed on the pilot study as described earlier in this chapter, made the construction of the final test possible. The auditory stimuli, played by a professional pianist and recorded on magnetic tape, are those items which were found to be statistically significant in the pilot study.

Rhythmic patterns.-- The rhythmic patterns are specifically selected, with some of the patterns basic walking or running beats; some the rhythm of skips and gallops; and others the fundamental rhythms found in the tango, the rumba, and the polka. The note values of these steps were prepared and formed into measures for use as auditory stimuli. Rhythms of varying note values and tempo in 2/4, 3/4, and 4/4 are included. Plate 3 contains the set of fifteen rhythmic patterns to be used.

This image displays 15 numbered rhythmic patterns on a five-line staff. The patterns are as follows:

- 1:** Four quarter notes in 4/4 time.
- 2:** Four whole notes in 4/4 time.
- 3:** Four quarter notes in 4/4 time.
- 4:** Four quarter notes in 4/4 time.
- 5:** Four eighth notes in 4/4 time.
- 6:** Eight eighth notes in 4/4 time.
- 7:** Four eighth notes in 4/4 time.
- 8:** Eight eighth notes in 4/4 time.
- 9:** Four eighth notes in 4/4 time.
- 10:** Four eighth notes in 4/4 time.
- 11:** Four eighth notes in 3/4 time.
- 12:** Four eighth notes in 4/4 time.
- 13:** Four eighth notes in 4/4 time.
- 14:** Four eighth notes in 4/4 time.
- 15:** Four eighth notes in 3/4 time.

Plate 3. List of Rhythmic Patterns

Two Sections of Auditory Rhythmic Stimuli.-- In the first section, the patterns are presented by the stimulus-response method, as described on page 5. The second section includes the same measures, in varying order, as continuing rhythmic patterns. The order of the second section with its relation to the first section follows:

Table 3. Order of Continuing Rhythmic Patterns:

Continuing rhythm item number (Second Section)	Stimulus-response item number (First Section)
16	8
17	15
18	4
19	12
20	7
21	1
22	14
23	6
24	2
25	10
26	13
27	3
28	11
29	5
30	9

The tape.-- The auditory rhythmic stimuli are presented to the subject on magnetic tape, played on a tape recorder. In order to insure uniform presentation, the instructions including three practice patterns are included on the tape. The time required for these stimuli is 12 minutes.

The Presentation.-- In order to insure constant presentation to all subjects, the instructions are incorporated on the tape with the auditory rhythmic stimuli. The following is included:

"This is a rhythm test. For this section of the test you will stand on the starting box and listen to a measure of rhythmic beats. On the signal, you will step out every beat you hear on the red panels. When you have finished your repetition of the rhythmic pattern, return to the starting box to await the next pattern. Listen to the pattern, wait for the signal, make your response, and return to the starting platform.

Here is a practice pattern...."

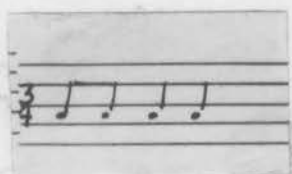


Plate 4. Practice Pattern I. Stimulus-Response

"Now try two more practice patterns."

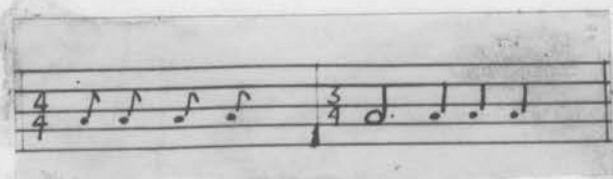


Plate 5. Practice Patterns II and III--  
Stimulus-Response

"Ready now for the test itself."

The subject is then presented with the first section of the test. This section consists of 15 stimulus-response patterns.

(see Plate 3. List of Rhythmic Patterns, page 27).



The second section follows item 15. The directions are as follows:

"For this section of the test, each measure will be repeated several times. When you feel that you can step every beat with the music, do so. Return to the platform after each group of patterns. Here is a practice pattern."

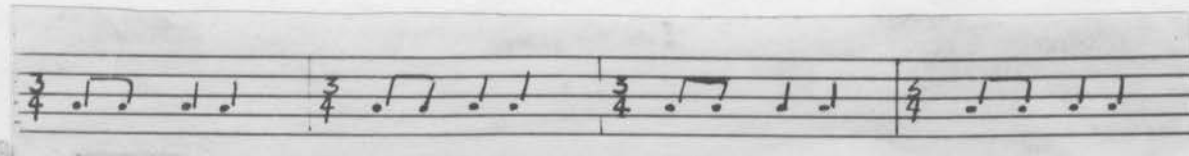


Plate 6. Practice Pattern I--Continuing Rhythm

"Now try two more practice patterns."

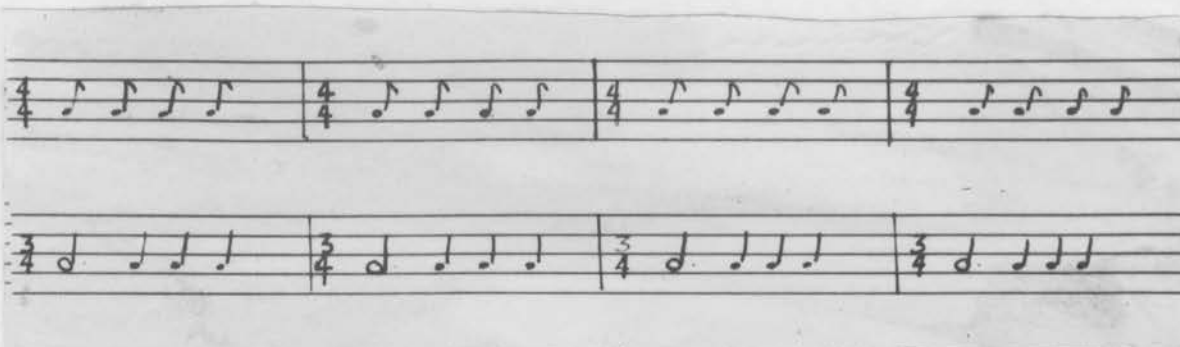
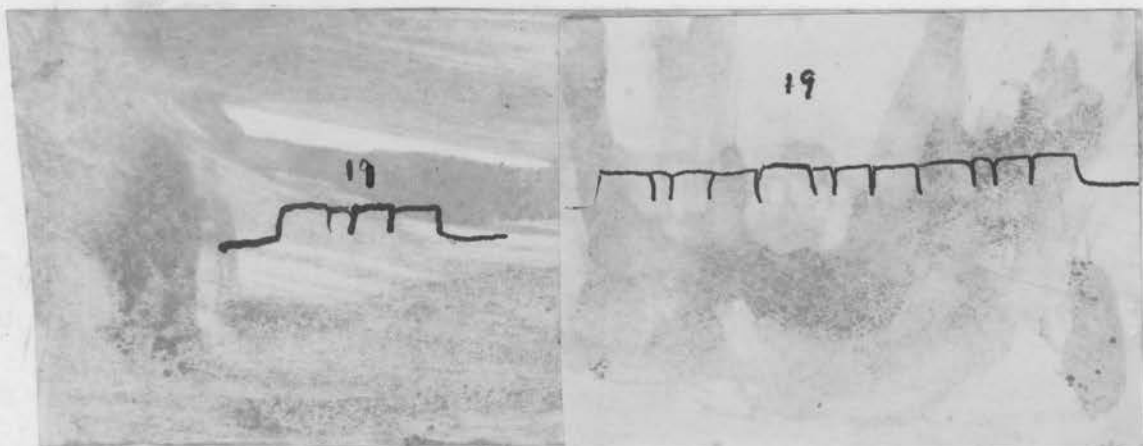
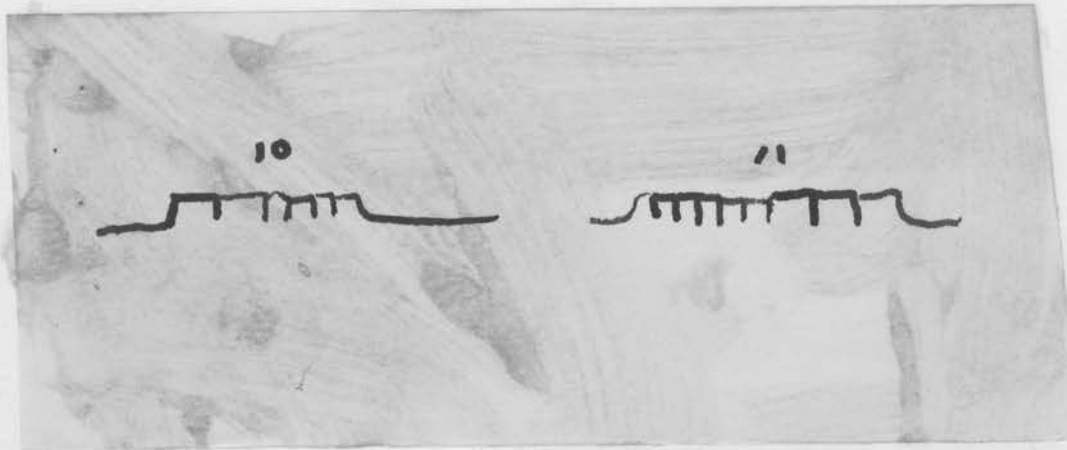


Plate 7. Practice Patterns II and III.  
Continuing Rhythm

The subject is then presented with the second section, which consists of 15 continuing rhythm patterns.

Scoring.--For the instrument to measure locomotor response (Rhythmeter), a scoring key was constructed of clear plastic

material. The correct responses are drawn in ink on the key, so that when the key is placed on top of the subject's response both may be seen. A subject response which matches the scoring key pattern within one mm. will be considered to be a correct item. For the continuing response rhythms, an item will be considered correct if any measure corresponds to the scoring key. The number of correct responses will determine the test score.



Sample subject Response

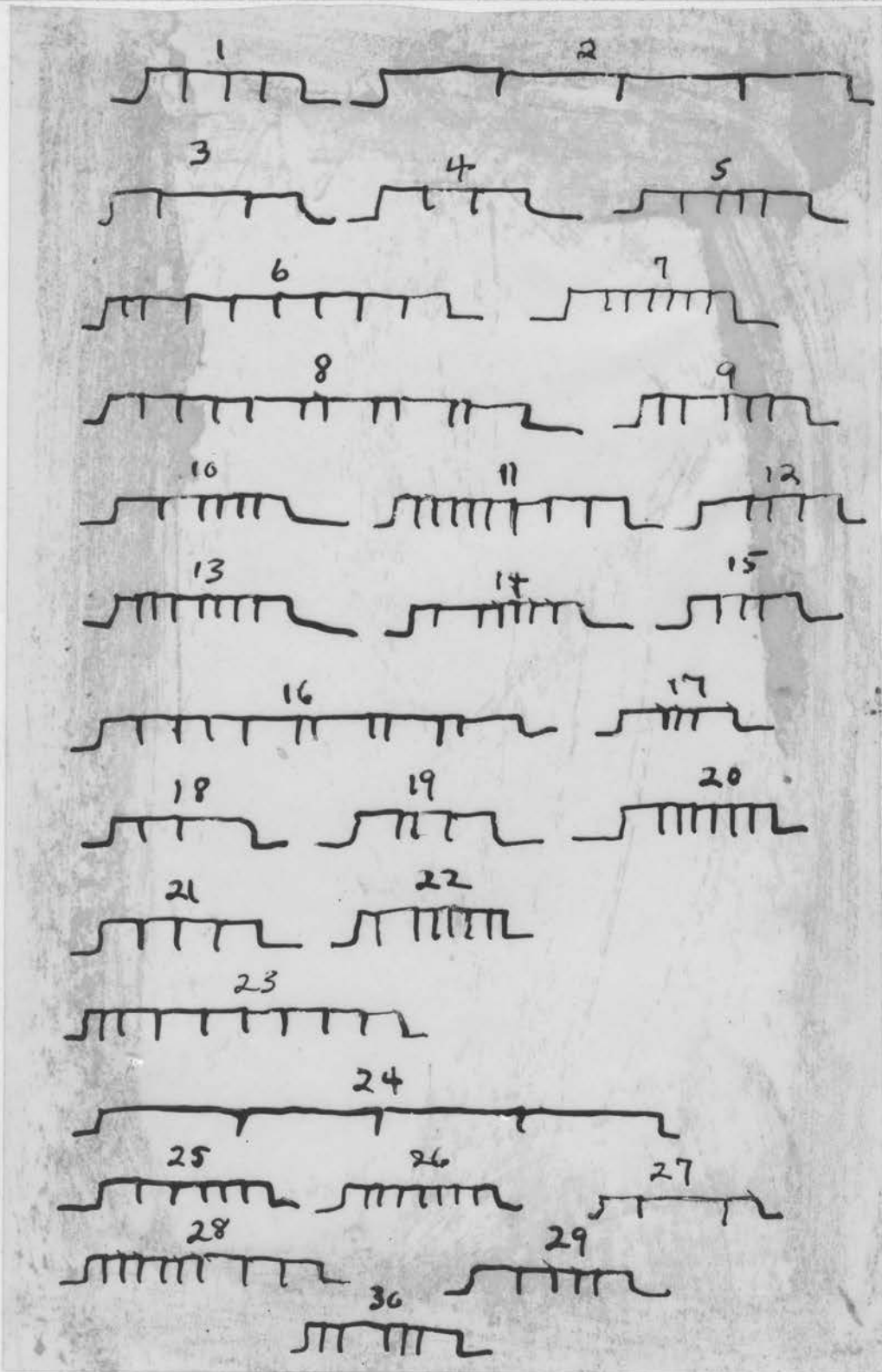


Plate 8. Scoring Key

## 5. Commercial Tests Incorporated in Study

The sensory tests to be administered to the subjects of this study are the rhythmic identification and time discrimination sections of the Kwalwasser-Dykema Music Tests.<sup>1/</sup>

Rhythmic Identification Test.-- This test consists of twenty-five paired items of the same or different rhythms. The subject must identify the pairs as same or different and record her answer on a score sheet.

Time discrimination.-- This test involves twenty-five items of three tones each. The tones may be the same or different, and the subject must so record her response.

Scoring.-- Each correct item on these tests, as compared with a matrix supplied in the test kit, is added, and the total number correct becomes the subject's score.

## 6. Populations Studied

Two experimental and one control group are used as subjects for this study. The experimental groups involve trained amateur and professional dancers. The control group consists of members of the general college population. All of the subjects are women.

Professional Dancers.-- For this study thirty-eight professional dancers are used. By virtue of their specific training and interests, the scores achieved by professional

<sup>1/</sup>Jacob Kwalwasser and Peter Dykema, op. cit.

dancers should aid in the establishment of the validity of the measure of locomotor response to auditory rhythmic stimuli. All of the individuals of this group have had at least three years of professional experience.

Table 4. Distribution of Professional Dancers

Number of Cases	Source of Experience
9	Radio City Music Hall, New York, New York
10	Blinstrub's Village, Boston, Massachusetts
14	The Frolic, Revere, Massachusetts
5	Single Acts, Boston, Massachusetts
38	Total

Dance Club Members from Major Physical Education Programs-- The second experimental group involved is composed of forty-two members of the dance clubs in professional schools or colleges of physical education. This group was selected for study because of interest in the field of dance on the part of the members. Many of these subjects are planning to teach dance in schools and colleges following their graduation from the professional program. Some of the subjects used in this category are former dance club members who are already teaching dance.

Table 5. Distribution of Dance Club Members

Number of Cases (42)	School or College
14	Bouve-Boston School of Physical Education Medford, Massachusetts
19	Sargent College of Physical Education, Boston University, Cambridge, Massachusetts
9	Alumnae of both

General College Population:-- For the study eighty-nine members of the general college population are used to provide the control group. The individuals in this study group are those selected at random from two liberal arts colleges. This is a group which does not expect to use rhythm or dance skills professionally, and which perhaps has a lesser degree of interest in rhythm and dance. Representatives from all classes are included.

Table 6. Distribution of General College Population

Number of Cases (89)	College
55	Simmons College, Boston, Massachusetts
34	Rivier College, Nashua, New Hampshire

## 7. Statistical Procedures to Be Used for Treatment of the Data

For the instrument to measure locomotor response, the statistical analysis will be accompanied by several methods. The reliability will be determined by means of Hoyt's Formula<sup>1/</sup> using the analysis of variance technique. The null hypothesis that no differences exist among study groups will be tested. A test of significance of difference of the means will be made to determine the relationship of each group to the others. The raw scores will also be treated for their distribution by derivation of range, means, and standard deviation.

It will be established that a one percent level of confidence will be considered to be statistically significant as evidence of difference in group results.

Internal consistency will be statistically determined by means of the Phi Coefficient method.

The Pearson Product Moment coefficient of correlation, (hereafter referred to as "r") will be used to determine the relationships between the scores on the instrument to measure locomotor response (Rhythmeter) and scores on the sensory tests.

<sup>1/</sup>Palmer O. Johnson, Statistical Methods in Research, Prentice-Hall, Inc., New York, 1949, p. 134.

## CHAPTER IV

### PRESENTATION AND ANALYSIS OF DATA

Two experimental and one control group were involved in the study. The participants included women from the general college population (control group); dance club members from major programs of physical education, and professional dancers (experimental group).

An analysis of the scores obtained on the tests, administered as described in the preceding chapter, produced the following results. The composition of the control and experimental groups is shown in the table below.

Table 7. Composition of the Study Groups

Group	Number of Cases	
Control		
General College population	89	
Simmons College, Boston, Massachusetts		55
Rivier College, Nashua, New Hampshire		34
Experimental Group	80	
Dance Club Members	42	
Bouve -Boston School of Physical Education, Medford, Massachusetts		14
Sargent College of Physical Education, Boston University, Boston, Massachusetts		19
Alumnae from both		9
Professional Dancers	38	
Radio City Music Hall, New York		9
Blinstrub's Village, Boston, Massachusetts		10
The Frolic, Revere, Massachusetts		14
Single acts - Independent dancers.		5



1. Instrument to Measure Locomotor Response to Auditory Rhythmic Stimuli (Rhythmeter).

All of the subjects performed on the instrument to measure locomotor response to auditory rhythmic stimuli (Rhythmeter). The distribution of the scores is as follows:

Table 8. Scores Determined by Results on Instrument to Measure Locomotor Response (Rhythmeter).

Group	Number of Cases (169)	Range of Scores (30)	Mean	S.D.
Control Group General College Population	89	1 - 27	8.1	6.5
Experimental Groups				
Dance Club Members	42	13 - 28	20.3	4.5
Professional Dancers	38	12 - 29	21.7	4.4
Combined exper- imental groups	80	12 - 29	20.9	4.4

There is a wide range in the scores of the control group (1-27), a result to be expected from a random sampling. The mean (8.1) was relatively low. The scores of the experimental groups combined showed a smaller range (12-29) with a relatively high mean. The combined experimental group included dance club members from major programs of physical education (mean 20.3, range 13-28) and professional dancers (mean 21.7, range 12-29).

Reliability.-- In order to determine statistically the reliability of the instrument to measure locomotor response to

auditory rhythmic stimuli (Rhythmeter), Hoyt's Formula <sup>1/</sup> for applying the analysis of variance technique was used. The results of this analysis are shown below:

Table 9. Analysis of Variance (Hoyt's Formula) <sup>2/</sup> of Scores on Instrument to Measure Locomotor Response (Rhythmeter) on the General College Population (Control Group) (N-89).

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F	Hypothesis Tested
Between Individuals	88	128.1	1.46	11.8	Reject
Between Items	29	31.0	1.07	8.7	Reject
Residual	2552	313.6	.123		
Total	2669	572.7			

$$r = \frac{1.46 - .123}{1.46} = \frac{1.327}{1.46} = .91. \text{ Split half "r" } .89.$$

$$S_E = \sqrt{\frac{313.6}{88}} = \sqrt{3.56} = 1.89 \text{ score units}$$

The F-ratio both between items and between individuals was found to be statistically significant and the hypothesis that no difference existed was rejected. The coefficient of reliability of the instrument to measure locomotor response determined by the above technique was found to be .91. The standard error indicates that on a re-test, an individual would score within 1.89 points of her original scores.

<sup>1/</sup>Palmer O. Johnson, Ibid., p. 134.

<sup>2/</sup>Loc. cit.

Table 10. Analysis of Variance (Hoyt's Formula)<sup>1/</sup> of Scores on Instrument to Measure Locomotor Response (Rhythmeter) on the Dance Club Members from Major Programs of Physical Education (Experimental Group)

(N-42)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F	Hypothesis Tested
Between Individuals	41	22.211	.542	3.85	Reject
Between Items	29	50.654	1.748	10.2	Reject
Residual	1189	202.310	.171		
Total	1259	275.175			

$$r = \frac{.371}{.542} = .68. \text{ Split half "r" } .89.$$

$$s_E \sqrt{\frac{202.31}{41}} = \sqrt{4.95} = 2.22 \text{ score units}$$

N-38)

The F-ratio both between the individuals and between items is statistically significant and allows the rejection of the hypothesis that the observed differences are due to chance. The coefficient of reliability for the test obtained from the scores of dance club members is .68.

<sup>1/</sup>Loc. cit.

Table 11. Analysis of Variance (Hoyt's Formula)<sup>1/</sup> of Scores on Instrument to Measure Locomotor Response (Rhythmeter) on Professional Dancers (Experimental Group)

N-38

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F	Hypothesis Tested
Between Individuals	37	19.6579	.53	2.34	Reject
Between Items	29	34.6579	1.95	8.65	Reject
Residual	1073	226.16	.226		
Total	1139	280.4758			

$$r = \frac{.304}{.53} = .575. \text{ Split half "r" } .87.$$

$$S_E = \frac{\sqrt{226.16}}{37} = \frac{.53}{\sqrt{6.12}} = 2.47 \text{ Score units}$$

The F-ratio for variance between individuals and items are both high enough to justify rejection of the null hypothesis. The coefficient of reliability for the test, obtained by the technique, is .575.

Table 12. Analysis of Variance (Hoyt's Formula)<sup>2/</sup> of Scores on Instrument to Measure Locomotor Response (Rhythmeter) on Combined Experimental Groups.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F	Hypothesis Tested
Between Individuals	79	43.326	.549	2.95	Reject
Between Items	29	72.659	2.51	13.5	Reject
Residual	2291	386.810	.186		
Total	2399	502.795			

$$r = \frac{.363}{.549} = .66. \text{ Split half "r" } .88.$$

$$S_E = \frac{\sqrt{386.81}}{79} = \frac{.186}{\sqrt{4.77}} = 2.18 \text{ score units}$$

<sup>1/</sup>Loc. cit.

<sup>2/</sup>Loc. cit.

The F-ratios for the variance between individuals and items are statistically significant and permit the rejection of the null hypothesis. The coefficient of reliability of .66 was obtained from the scores of the combined experimental group, which includes dance club members and professional dancers.

The results of the application of the analysis of variance (Hoyt's Formula)<sup>1/</sup> are statistically significant to accept the instrument to measure locomotor response (Rhythmeter) as reliable.

Correlation of Halves.-- Reliability of the instrument was shown further by determining the coefficient of correlation between the two halves of the test. As the same rhythmic patterns were used for the stimulus-response items and the continuing rhythm items, a coefficient of correlation was determined for the halves of the test.

Table 13. Correlation Coefficient between Stimulus-Response and Continuing Rhythm Items

Test Half	Range (15)	Mean	S.D.	Pearson "r"
Stimulus-Response	0-14	6.25	3.73	.89
Continuing Rhythm	1-15	10.97	4.55	

A very high correlation is found to exist between the stimulus-response and continuing rhythm items.

<sup>1/</sup>Loc. cit.

Validity.-- Validity is determined by a test of significance for the differences among the means of the study groups. There was an obvious difference between the ability of the control group and the experimental group in performance. The instrument to measure locomotor response has face validity. The auditory rhythmic stimuli are similar to those used in dance. Actual locomotor response is required, and the response automatically recorded.

Table 14. Significance of Differences between Means on Study Groups on Performance on Instrument to Measure Locomotor Response (Rhythmeter)

Groups Compared	Mean	S.D.	T	Level of Confidence	Hypothesis Tested
(C)General College Students	8.1	6.5	12.6	P 1%	Reject
(E)Dance Club	20.3	4.5			
(C)General College	8.1	6.5	13.7	P 1%	Reject
(E)Professional Dancers	21.7	4.4			
(E)Dance Club	20.3	4.5	1.4	P .0808	
(E)Professional Dancers	21.7	4.4			
(E)Combined Experimental Groups	20.9	4.4	13.1	P 1%	Reject
Control Group	8.1	6.5			

C= Control Group  
E= Experimental Group

A T-ratio was used as a test of significance among the means for the several groups. "A T ratio of 2.5 warrants the conclusion that the observed differences are due to factors other than chance."<sup>1/</sup> The null hypothesis was rejected on this basis, except between the dance club members from major programs of physical education and professional dancers (combined experimental group), where the statistical differences were not significant.

## 2. Sensory Tests

The scores of the instrument to measure locomotor response (Rhythmeter) were correlated with those of the rhythmic identification and time discrimination sections of the Kwalwasser-Dykema Music Tests,<sup>2/</sup> using the Pearson Product Moment Correlation Coefficient.

1/John C. Peatman, Descriptive and Sampling Statistics, Harper Brothers, New York, 1947, p. 143.

2/Loc. cit.

Table 15. Significance of Difference of Means between Study Groups on Rhythmic Identification <sup>1/</sup> Section of Kwalwasser-Dykema Music Tests

Groups Compared	Mean	S.D.	T	Level of Confidence	Hypothesis Tested
(C)General College Population	17.74	1.8			
(E)Dance Club	20.9	1.12	.26	P 39%	Uphold
(C)General College Population	17.74	1.8	.39	P 34%	Uphold
(E)Professional Dancers	21.52	1.79			
(C)Dance Club	20.9	1.12	.16	P 43%	Uphold
(E)Professional Dancers	21.52	1.79			
(C)General College Population	17.74	1.8	.55	P 29%	Uphold
(E)Combined Experimental Groups	21.3	1.51			

The results of the test of significance of means in this table indicate that there is no statistically significant difference among the means of the study groups. This may be interpreted to mean that there is no greater aptitude for rhythmic identification among the experimental groups than is found in the control group.

<sup>1/</sup>Loc. cit.



Table 16. Significance of Difference of Means between Study Groups on Time Discrimination Section of Kwalwasser-Dykema Music Tests.<sup>1/</sup>

Groups Compared	Mean	S.D.	T	Level of Confidence	Hypothesis Tested
(C)General Student Population	12.87	2.92	.12	45%	Uphold
(E)Dance Club	13.65	3.38			
(C)General Student Population	12.87	2.92	.11	46%	Uphold
(E)Professional Dancers	14.64	3.65			
(E)Dance Club	13.65	3.38	.04	48%	Uphold
(E)Professional Dancers	14.64	3.65			
(C)General Student Population	12.87	2.92			
(E)Combined Experimental Groups	15.64	3.91	.18	43%	Uphold

The levels of confidence as determined on the ratio of variance demonstrate that the hypothesis cannot be rejected. The evidence indicates that there is a relatively high degree of relationship between the means examined.

The distribution of mean scores on these tests indicates no statistical significance between the means of the various groups, a very different situation from that found in the distribution of scores on the instrument to measure locomotor response (Rhythmeter).

<sup>1/</sup>Loc. cit.

A Pearson Product Moment "r" was obtained by correlating the scores of the control and experimental groups with the rhythmic identification and time discrimination tests.

Table 17. Correlation of Scores between Instrument to Measure Locomotor Response (Rhythmeter) and Rhythm Identification Section of Kwalwasser-Dykema Music Tests.<sup>1/</sup>

Groups	Number of cases (122)	Range of scores (25)	Mean	S.D.	"r"
Control Group General College Population	82	12-24	17.74	1.8	.081
Experimental Groups					
Dance Club Members	20	15-23	21.9	1.12	.56
Professional Dancers	20	15-23	21.52	1.79	.59
Experimental Groups Combined	40	15-23	21.31	1.51	.56

The range of scores between the control group (12-24) and experimental groups is not significantly different. None of the coefficients of correlation are high enough to provide conclusive evidence of correlation.

<sup>1/</sup>Loc. cit.

Table 18. Correlation of Scores between Instrument to Measure Locomotor Response (Rhythmeter) and Time Discrimination Section of Kwalwasser-Dykema Music Tests.<sup>1/</sup>

Groups	Number of Cases (122)	Range of Scores (25)	Mean	S.D.	"r"
Control General College Population	82	12-23	15.17	2.92	-.167
Experimental Dance Club Members	20	11-23	16.58	2.65	.45
Professional Dancers	20	12-23	14.64	2.69	.37
Combined Experimental Group	40	11-23	15.36	2.85	.39

There is no evidence to determine a high positive degree of correlation between scores received on the instrument to measure locomotor response and the time discrimination section of the Kwalwasser-Dykema Music Tests.<sup>2/</sup>

<sup>1/</sup>Loc. cit.

<sup>2/</sup>Loc. cit.

### 3. Internal Consistency

The Phi Coefficient method was used. The relationship of Phi to Chi Square provides a test of minimal significant coefficients. The one percent level of confidence was .24. The upper and lower 60 cases (38.8% of the cases of each part) were used.

Table 19. Internal Consistency as Determined by Phi Method

Item Number	Upper Scores Correct	%	Lower Scores Correct	%	$\phi$
1	43	72	18	30	.42
2	23	38	2	3	.40
3	27	45	5	8	.42
4	49	82	13	22	.60
5	51	85	15	25	.60
6	36	60	3	5	.60
7	49	82	13	22	.60
8	23	38	0	0	.49
9	51	85	17	28	.57
10	56	93	14	23	.70
11	43	72	13	22	.50
12	52	87	21	35	.53
13	42	70	17	28	.42
14	50	83	9	15	.68
15	57	95	8	13	.82
16	52	87	9	15	.72
17	41	68	15	25	.43
18	55	92	20	33	.60
19	50	83	6	10	.73
20	56	93	7	12	.80
21	56	93	11	18	.75
22	54	90	12	20	.70
23	43	72	42	70	.02
24	50	83	15	25	.58
25	57	95	3	5	.90
26	39	65	6	10	.56
27	50	83	4	7	.75
28	51	85	13	22	.63
29	55	92	3	5	.87
30	57	95	2	3	.92

The Phi range was from .92 to .02. As the level of confidence for one per cent was .24, all scores but one were significant. The mean was .61, and the standard deviation 14.7. Only one item fell below .40, indicating that the differences observed between the upper and lower groups were not due to chance.

CHAPTER V  
SUMMARY AND CONCLUSIONS

1. Summary

The purpose of the study was to develop an instrument to measure objectively locomotor response to auditory rhythmic stimuli in individuals from control and experimental groups. This measure was to be compared with sensory tests which involved a written response.

The study was undertaken in recognition of the need for such an instrument cited in the review of literature. Locomotor response to auditory rhythm is generally regarded as an innate capacity, a characteristic that individuals possess in varying degrees. The extent to which an individual possesses this capacity is important for success in the field of dance.

An instrument was constructed to measure objectively locomotor response to auditory rhythmic stimuli. The apparatus involved (called the Rhythmeter) consists of a tape containing instructions and auditory rhythmic stimuli, a tape recorder, a hinged platform on which the subject performs, and a rotating drum on which is recorded the subject's responses. It can be used wherever ordinary electric "house" current is available.

The measure to determine locomotor response to auditory rhythmic stimuli is easy to administer and is brief (12 minutes). It is simple to score by means of a plastic mask. Its range of difficulty is such that no individual of those tested made a perfect score, yet none failed to make at least one perfect response. A one per cent level of confidence was established as the level at which the data would be statistically significant.

The study groups were composed of 89 women from the general college population (control group); 42 dance club members from major programs of physical education, and 38 professional dancers (experimental group).

The reliability of the instrument to measure locomotor response (Rhythmeter), as determined by Hoyt's Formula, involving the analysis of variance, was significant at the one per cent level.

In support of the validity of this measure of locomotor response, several facts can be presented. It has face validity, in that it is a performance test in which the subject actually demonstrates her locomotor response to the auditory rhythmic stimuli. Statistical support of validity was established by determining the significance of the difference of the means of the control and experimental groups. The mean of the control group (8--8.1) was compared with that of the combined experimental group. Within the experimental group, the mean

of dance club members was 20.3, and the professional dancers, 21.7. These differences in means of the sub-groups are not statistically significant. The differences in means of control and experimental groups is significant at below the one percent level of confidence.

The rhythmic identification and time discrimination sections of the Kwalwasser-Dykema Music Tests <sup>1/</sup> were administered to participants from all study groups. A scoring matrix for these tests was provided in the test kit.

The test of significance for the difference between means on the Kwalwasser-Dykema Music Tests <sup>2/</sup> were negative. In comparing the means of the control and experimental groups, the level of confidence was determined to be above the one percent level, thus being not statistically significant for this study. Within the experimental group, the level of confidence was above the one percent level, therefore the hypothesis that no differences exist within groups is maintained.

The coefficient of correlation between the scores obtained by participants on the Rhythmeter and Kwalwasser-Dykema tests were found to be low. The general college population (control group) had .081 on the rhythm identification section, and an "r" of -.167 on the time discrimination.

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1/Loc. cit.

2/Loc. cit.



The combined experimental groups had a .46 "r" on the rhythmic identification, and a .39 "r" on the time discrimination section. Within the experimental groups, the dance club members were found to have an "r" of .56 for rhythmic identification, and of .55 for the time discrimination. The professional dancers had an "r" of .59 on the rhythmic identification section and -.37 on time discrimination. The total study group correlation with instrument to measure locomotor response on the rhythmic identification section was -.26, and on the time discrimination comparison, the "r" was -.32.

## 2. Conclusions

An instrument to measure objectively differences in locomotor response to auditory rhythmic stimuli has been developed, and found to be reliable.

Within the experimental study group (dance club members from major programs of physical education and professional dancers), no significant differences were found on the instrument to measure locomotor response (Rhythmeter).

Control (general college population) and experimental (trained amateur and professional dancers) groups of women indicate that individual and group differences exist in locomotor response to auditory rhythmic stimuli, to a statistically significant degree.

No statistical evidence was found to indicate significant differences in control and experimental groups for the Kwalwasser-Dykema Music Tests.<sup>1/</sup>

No significant relationship exists between the instrument to measure locomotor response to auditory rhythmic stimuli and the Kwalwasser-Dykema Music Tests<sup>2/</sup> (rhythmic identification and time discrimination) within the total study group, or between the control group (general college population) and the experimental groups. Within the experimental groups (dance club members and professional dancers) no significant correlation exists.

Results of this study indicate that performance on the instrument to measure locomotor response to auditory stimuli may serve as an indication of rhythmic ability, which is a basic need in the field of the dance.

### 3. Suggestions for Further Study

This study has made a beginning in the field of objective measurement of locomotor response. Much more research needs to be done. Some suggestions for further study follow.

The establishment of norms for the measurement of locomotor response to auditory rhythmic stimuli.

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1/Loc. cit.

2/Loc. cit.

A comparison study of differences in results among males and females.

A comparison of scores made on the instrument to measure locomotor response to auditory stimuli with athletic skill.

A study of locomotor response to other stimuli, such as light or touch.

A comparison of the response to auditory rhythmic stimuli by locomotor activity (Rhythmeter) and by motor (hand) reaction.

A study of group results on the instrument to measure locomotor response (Rhythmeter) with an experimental group to experience concentrated practice in rhythms and dance.

A growth study over an extended span of time to determine the relationship of scores of individuals at one age, and the same subjects' scores when older.

#### 4. Limitations of the Study

This study was a pioneer effort in the field of objective measure of locomotor response to auditory rhythmic stimuli.

It is subject to certain limitations which follow.

Sex differences were not investigated.

Norms were not established.

The size of the population samples were comparatively small.

Comparisons between locomotor response and motor response were not made.

Whether or not the dancers also have high athletic skill was not measured.

A comparison of practice and non-practice effects on performance was not made.

**APPENDIX**

Table 20. Total Raw Scores  
General College Population

19-0

		Rhythmeter Test																													
Case Number		Items Passed																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	.....									X														X							
2	.....			X						X		X	X	X			X		X				X								
3	.....	X				X						X	X					X		X											
4	.....		X			X					X			X						X			X						X		
5	.....	X			X						X		X						X				X								
6	.....			X						X			X						X				X				X				
7	.....				X					X			X						X				X				X				
8	.....											X	X	X									X								
9	.....						X						X										X								
10	.....	X			X		X				X	X							X				X					X			
11	.....	X		X						X	X			X					X		X		X				X				
12	.....		X		X	X				X	X		X					X		X		X						X			
13	.....	X		X			X			X	X		X						X				X			X			X		
14	.....	X			X					X	X		X								X			X					X		
15	.....	X			X		X				X						X						X		X						
16	.....			X						X	X		X										X								
17	.....			X		X				X	X		X						X		X		X						X		
18	.....			X		X		X		X	X		X		X			X		X		X		X			X				
19	.....		X				X		X	X		X					X		X			X		X						X	
20	.....			X			X		X	X		X		X					X			X		X			X				X
21	.....			X			X		X	X		X		X					X		X		X		X			X			
22	.....		X				X			X		X		X								X		X				X			
23	.....	X												X					X			X					X				

(continued on next page)

		Kwalwasser-Dykema	
Total Score	Music Tests	Rhythm Scores	Time Scores
2			
8			
6	21		15
8	22		20
8	19		13
7	20		12
5	21		18
7	18		17
4	18		17
2	20		15
8	22		21
10			
8	20		21
11			
7	20		17
8	20		15
3	18		12
7	22		21
10	20		22
9			
9	21		15
8	20		19
6			
4			

(continued on next page)

Table 20. (continued)

Rhythmeter Test																															
Case Number	Items Passed																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
24....		x	x	x			x	x		x										x	x	x			x						
25....	x	x	x	x		x	x		x			x	x				x	x	x	x	x				x				x		
26....																				x	x										
27....			x							x		x						x													
28....												x					x			x											
29....							x		x			x	x																		
30....				x	x							x					x			x	x								x		
31....																		x													
32....					x				x			x																			
33....	x						x										x	x													
34....	x					x					x						x	x				x					x				
35....										x		x						x	x		x										
36....							x		x									x													
37....				x		x		x				x	x	x			x												x		
38....	x												x				x														
39....																			x												
40....	x																														
41....	x			x								x													x						
42....	x										x														x						
43....	x			x									x																x		
44....	x			x	x							x	x																		
45....																				x											
46....	x			x									x																		
47....												x	x																		
48....		x											x																		

(continued on next page)

Total Score	Kwalwasser-Dykema Music Tests	
	Rhythm Scores	Time Scores
13	18	21
19		
3	19	13
3	20	19
3	21	21
3	21	12
5		
5	20	11
2	18	13
4	21	19
4	20	19
8	22	20
7	21	20
4	21	18
10	21	18
4	17	18
2	20	18
1	18	21
5		
5	21	19
5	16	19
6	20	14
8	19	15
1	20	13
4	19	17
3	17	14

(continued on next page)

Table 20. (continued)

Rhythmeter Test																														
Case Number	Items Passed																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
49.....									X			X		X			X		X			X	X							
50.....				X	X		X		X			X											X					X		
51.....													X				X	X					X					X		
52.....			X																				X							
53.....	X					X			X					X			X							X			X			
54.....											X						X													
55.....		X		X	X		X		X	X				X	X		X	X			X		X				X			
56.....	X			X	X		X		X					X	X		X	X	X	X		X		X		X	X			X
57.....			X	X	X		X		X	X				X	X		X	X	X		X		X	X				X	X	X
58.....	X	X	X	X	X		X		X	X	X			X	X	X	X		X	X	X		X	X		X	X			X
59.....																														
60.....	X	X	X	X	X				X	X	X			X	X	X	X	X		X	X	X		X		X	X			X
61.....	X	X		X	X				X			X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
62.....				X										X	X	X					X	X				X	X	X		
63.....	X								X			X		X	X						X			X	X					
64.....				X	X	X				X	X			X	X					X				X	X					
65.....	X		X				X		X			X				X			X	X			X		X	X		X	X	X
66.....									X						X						X		X							
67.....	X		X				X		X	X					X			X		X	X			X		X				X
68.....								X				X			X	X		X	X			X			X	X		X	X	X
69.....				X	X				X			X						X	X			X			X		X	X	X	X
70.....			X	X				X				X		X	X	X	X	X	X	X	X	X		X	X		X	X	X	X
71.....		X		X					X			X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
72.....			X		X				X			X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X

(concluded on next page)

Total Score	Kwalwasser-Dykema Music Tests	
	Rhythm Scores	Time Scores
7	19	20
7	21	18
5		
2	18	20
7		
2		
11	18	18
12	21	14
14	18	18
21	19	12
1	17	14
19	21	17
23	18	19
10	18	20
9	20	20
8	18	18
14	22	15
4	18	13
12	22	23
11	24	22
11	18	12
16	17	15
20	20	19
13	21	17

(concluded on next page)



Table 20. (concluded)

Rhythmeter Test																														
Case	Items Passed																													
Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
73....	x	x		x		x		x	x	x	x			x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	
74....	x			x	x	x	x	x	x	x	x			x		x	x	x	x	x	x				x	x	x	x	x	
75....				x	x	x			x	x	x	x	x		x		x		x	x	x		x	x	x	x	x	x	x	
76....	x		x	x	x	x			x	x	x	x		x	x	x		x	x	x	x	x		x	x	x	x	x	x	
77....				x		x				x	x	x	x		x		x	x			x	x	x	x		x	x	x	x	
78....			x	x	x	x			x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	
79....			x	x						x	x				x			x			x				x				x	
80....															x			x									x		x	
81....										x	x	x	x		x	x					x	x								
82....	x								x			x			x	x		x	x					x				x	x	
83....	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	
84....				x	x			x				x				x	x	x			x			x	x			x		
85....	x			x	x		x		x	x	x	x			x	x	x			x	x	x		x	x	x	x	x	x	
86....									x						x			x						x			x		x	
87....	x	x	x	x	x					x			x	x	x			x	x	x	x	x		x	x	x	x	x	x	
88....																		x			x			x						
89....			x	x	x	x				x	x			x	x	x			x		x	x	x		x					x

Total Score	Kwalwasser-Dykema Music Tests	
	Rhythm Scores	Time Scores
23	22	20
23	21	15
23	21	22
26	18	14
17	20	15
26	22	19
10	19	23
4	20	16
8	19	16
10	21	20
27	21	20
12	18	20
23	18	15
6	20	20
21	17	17
3	19	18
15	12	15

Table 21. Total Raw Scores  
Major Program--Dance Club Members.

Case Number	Rhytmeter Test																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	x			x	x		x			x	x	x		x	x		x			x	x	x	x	x	x	x	x	x	x	x
2			x	x	x	x	x	x		x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
3	x	x	x		x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4	x		x	x	x		x	x	x		x	x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x
5	x			x	x		x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x
6	x	x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7	x			x		x	x		x	x		x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x
8	x		x	x			x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
9	x	x		x			x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
10			x	x	x		x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
11							x		x	x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
12			x						x			x	x		x	x	x	x	x		x	x	x	x		x		x	x	x
13	x			x	x	x	x		x	x		x	x	x	x	x	x	x	x		x	x		x	x	x	x	x	x	x
14	x				x	x	x		x	x		x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
15	x		x	x	x	x	x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
16	x	x		x	x	x	x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
17				x			x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
18	x			x	x				x			x	x		x	x		x	x	x	x	x		x	x	x	x	x	x	x
19	x			x	x	x	x		x	x		x	x		x	x		x	x	x	x	x		x	x	x	x	x	x	x
20	x			x					x	x		x		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
21	x				x				x	x		x	x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x
22	x	x		x	x	x	x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
23			x	x					x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

(concluded on next page)

Total Scores	Kwalwasser-Dykema Music Tests	
	Rhythm Scores	Time Scores
20	17	20
24		
25		
23		
22	19	20
28		
22	21	22
24		
22	22	17
21		
19	19	20
13	19	18
23	21	23
20	18	12
24	17	15
25	19	20
21		
19	19	19
21		
18		
15	21	13
27	21	20
19		

(concluded on next page)

Table 20. (concluded)

Rhythmeter Test																															
Case	Items Passed																														
Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
24....	x	x		x		x			x	x	x		x		x		x		x	x	x		x		x		x		x		x
25....	x			x	x		x		x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	
26....			x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
27....				x	x		x								x				x		x	x					x		x	x	
28....	x		x		x				x	x	x	x			x		x	x	x	x	x	x	x		x		x		x	x	
29....	x			x	x		x		x			x			x		x	x	x	x	x	x	x		x	x	x	x	x	x	
30....	x			x	x	x		x	x		x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
31....					x		x		x			x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
32....					x	x	x		x	x	x	x		x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	
33....	x			x	x	x			x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	
34....				x	x				x	x	x			x	x	x		x			x				x	x		x	x	x	
35....					x				x	x		x	x		x		x	x		x	x		x			x	x	x	x	x	
36....				x	x				x			x			x	x		x		x	x		x			x	x	x	x	x	
37....	x			x	x				x	x		x	x	x	x	x		x	x	x	x	x	x	x			x	x	x	x	
38....					x		x		x				x	x	x		x	x		x	x	x	x				x	x	x	x	
39....	x			x	x			x	x							x	x	x	x		x	x	x	x			x		x	x	
40....				x			x				x				x		x		x	x	x	x	x	x	x	x	x		x	x	
41....	x	x	x			x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
42....				x	x	x	x	x	x			x	x	x	x		x	x		x	x			x	x	x	x	x	x	x	

Kwalwasser-Dykema		
Total Scores	Music Tests	
	Rhythm Scores	Time Scores
19		
23	21	19
25	18	22
10	20	21
18	18	18
19		
23	21	21
19		
21	20	19
24		
16	19	19
16	19	17
14		
21	21	15
15		
16	20	17
15		
24	19	18
21		

Table 21. Total Raw Scores  
Major Program--Professional Dancers

Rhythmeter Test																														
Case	Items Passed																													
Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	....	x		x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x
2	....	x	x		x	x	x		x	x	x			x	x	x		x	x	x	x	x	x	x	x			x	x	x
3	....	x	x	x	x	x	x	x		x		x	x	x	x	x		x		x	x	x	x	x	x	x				x
4	....	x	x	x	x	x	x			x	x	x			x	x		x	x	x	x	x	x	x	x	x	x		x	x
5	....	x	x	x	x		x	x		x	x	x			x	x			x		x	x	x	x	x	x		x	x	x
6	....	x	x	x	x	x	x			x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x			
7	....				x					x	x				x			x	x		x	x	x	x					x	x
8	....		x		x	x	x	x	x	x	x	x	x	x	x	x	x		x		x	x				x		x	x	x
9	....	x			x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x	x	x	x
10	....	x	x			x	x	x		x					x			x	x	x	x	x		x			x		x	x
11	....									x			x		x	x		x	x		x	x	x	x	x	x	x	x	x	x
12	....	x			x					x				x	x			x	x		x	x		x	x		x	x	x	x
13	....				x	x		x		x	x			x	x			x		x		x	x	x	x	x				x
14	....	x		x		x	x	x		x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
15	....				x	x		x		x	x			x	x			x	x	x	x	x	x	x	x		x		x	x
16	....				x	x		x		x	x	x			x	x	x	x	x	x	x	x	x	x	x		x	x	x	x
17	....		x		x	x		x		x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
18	....	x			x	x		x		x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
19	....	x	x			x		x		x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
20	....				x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
21	....	x			x	x		x		x	x				x	x	x	x	x		x	x		x		x	x	x	x	x
22	....	x		x	x	x	x	x		x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
23	....	x	x			x		x		x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

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Total Scores	Kwalwasser-Dykema Music Tests	
	Rhythm Scores	Time Scores
27	19	14
23	21	20
22	20	18
27	21	18
22	18	11
25	23	16
12	15	11
23	20	16
25	20	13
17	19	16
15	18	16
16	19	17
16	20	15
25	21	18
19	21	19
21	19	18
22	21	23
23	17	18
21	21	19
25	22	16
19		

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Table 22 (concluded)

Rhythmeter Test																														
Case	Items Passed																													
Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
24.....	x			x	x	x		x		x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x		x	x	x
25.....	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
26.....			x	x					x	x		x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
27.....	x		x	x			x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x		x	x	x
28.....		x			x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x
29.....	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
30.....	x			x	x		x		x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x
31.....	x	x			x		x		x	x	x		x	x	x	x		x	x	x	x		x	x	x	x	x	x	x	x
32.....	x			x	x	x	x		x		x	x	x	x		x		x	x	x	x	x	x		x		x	x	x	x
33.....				x	x		x		x			x	x		x			x	x			x	x	x			x		x	x
34.....	x			x	x			x	x	x	x	x		x	x	x		x		x	x	x	x		x		x	x	x	x
35.....	x			x	x	x	x		x		x	x		x	x		x	x	x	x	x		x				x		x	x
36.....	x		x		x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
37.....	x	x		x	x	x		x	x	x		x	x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x
38.....		x		x	x	x		x		x	x	x		x	x	x		x	x			x	x		x	x		x	x	x

Total Scores
24
29
21
24
23
29
22
22
22
16
19
17
25
24
21

Table 23. Total Raw Scores  
Pilot Study  
High School Junior Class Girls

Rhythmeter Test																																
Case Number	Items Passed																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
1	....	x	x		x		x			x		x		x						x	x	x	x					x				
2	....			x		x	x			x			x	x		x	x								x	x				x		
3	....	x	x		x	x					x		x	x			x		x				x								x	
4	....		x	x		x							x	x																x		
5	....			x				x	x		x										x											
6	....		x		x		x						x	x			x				x			x	x	x	x					
7	....										x		x									x	x	x						x		
8	....		x		x	x			x		x						x					x	x	x		x	x			x		
9	....	x			x				x	x	x			x	x			x			x			x	x	x	x					
10	....		x								x			x								x	x	x	x	x	x			x		
11	....		x			x		x					x	x									x	x	x				x			
12	....			x	x	x	x			x		x													x							
13	....		x			x					x		x												x							
14	....		x				x	x	x								x								x							
15	....		x			x						x		x																		
16	....		x		x	x		x		x		x				x	x	x														
17	....										x											x		x							x	
18	....	x							x		x		x								x								x	x	x	
19	....	x		x			x		x	x	x		x																			
20	....		x			x		x					x									x								x		
21	....		x			x							x		x						x	x										
22	....	x				x		x						x												x		x				
23	....	x	x			x	x				x		x																x	x		

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Rhythmeter Test																															Total Scores				
Case Number																																			
	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46																			
1	....			x	x	x	x							x		x																	20		
2	....			x		x	x																											20	
3	....																																	19	
4	....																																	13	
5	....																																	10	
6	....																																	17	
7	....																																	10	
8	....																																	17	
9	....																																	24	
10	....																																	18	
11	....																																	19	
12	....																																	11	
13	....																																	15	
14	....																																	8	
15	....																																	21	
16	....																																	10	
17	....																																	13	
18	....																																	16	
19	....																																	12	
20	....																																	14	
21	....																																	11	
22	....																																		33
23	....																																		

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Table 23. (concluded)

Rhythmeter Test

Case	Items Passed																													
Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
24....				X								X		X					X				X	X	X	X	X			
25....	X			X	X			X				X		X			X		X				X		X	X	X			
26....	X			X				X	X	X					X			X								X				
27....	X	X	X	X				X	X		X		X	X				X			X		X	X						
28....	X		X	X		X		X			X	X						X			X									
29....			X			X		X			X		X				X		X				X							
30....	X	X			X		X		X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	
31....	X	X		X	X		X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	
32....				X							X								X				X							
33....	X		X	X		X		X	X	X	X	X			X		X	X	X		X			X		X				
34....										X	X		X				X	X	X	X	X	X	X	X	X	X	X	X	X	
35....	X				X		X				X						X	X		X										
36....	X				X												X	X	X						X	X	X			
37....	X	X		X			X				X		X				X	X	X				X					X		
38....	X	X	X	X		X			X	X	X	X	X		X		X	X	X	X	X		X	X	X	X	X	X	X	
39....			X	X	X		X			X	X	X		X			X	X	X				X		X			X	X	
40....	X			X							X		X	X	X		X			X			X		X	X	X			
41....	X						X	X					X	X	X															
42....	X												X											X						

Rhythmeter Test

Case	Items Passed																Total Scores
Number	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	
24	X					X	X			X	X						17
25	X			X		X				X		X	X	X	X		19
26			X	X													11
27	X		X	X				X		X		X	X	X	X		21
28	X		X	X		X		X		X		X	X	X	X		16
29			X														6
30	X			X		X		X	X		X	X	X	X	X		30
31	X	X	X	X		X	X	X	X	X	X	X	X	X	X		36
32		X	X	X													7
33	X	X	X											X	X	X	22
34	X			X		X		X		X		X	X	X	X		23
35		X															9
36										X			X	X	X		12
37	X			X						X		X	X	X	X		17
38	X	X	X							X	X	X	X	X	X	X	29
39			X	X	X		X			X	X	X	X	X	X	X	23
40	X			X						X	X	X	X	X	X	X	20
41	X						X	X				X	X	X	X		9
42	X											X	X	X	X		8

SELECTED BIBLIOGRAPHY



## SELECTED BIBLIOGRAPHY

1. Annett, Thomas, "Study in Rhythmic Capacity," Research Research Quarterly (April), 1932, pp. 32--36.
2. Ashton, Dudley, A Gross Motor Rhythm Test, Unpublished Master's Thesis, State University of Iowa, Iowa City, Iowa, 1952.
3. Baldwin, B. T. and L. I. Stecher, The Psychology of the Pre-School Child, D. Appleton Company, New York, 1924.
4. Buck, Nadine, "A Comparison of Two Methods of Testing Response to Auditory Rhythms," Research Quarterly (October), 1936, pp. 45-51.
5. Cleveland, Dorothy, A Study of Rhythmic Activities for the Primary Grade, Service Paper, Boston University School of Education, Boston, 1951.
6. Cowell, Henry, New Musical Resources, Alfred Knopf, New York, 1930.
7. Dixon, Wilfred and Frank J. Massey, Jr., Introduction to Statistical Analysis, McGraw-Hill Book Company, Inc., New York, 1951.
8. Flagg, Marion, Musical Learning, C. C. Birchard Company, Boston, 1949.
9. Gest, Elizabeth, "Walking Rhythm," Etude (April, 1957), 75:54.
10. Glassow, Ruth B. and Marion R. Broer, Measuring Achievement in Physical Education, W. B. Saunders Company, Philadelphia, 1939.
11. Guilford, J. P., Fundamental Statistics in Psychology and Education, McGraw-Hill Book Company, Inc., New York, 1950.
12. Hayes, Elizabeth R., Dance Composition and Production for High Schools and Colleges, The Ronald Press Company, New York, 1955.

13. Heinlein, Christian P., "A New Method of Studying the Rhythmic Responses of Children together with an Evaluation of the Method of Simple Observation," Journal of Genetic Psychology, (June, 1926), 26: 2:205--229.
14. Hollingworth, Leta S., "Musical Sensitivity of Children Who Test above 135 I. Q. (Stanford Binet)," Journal of Educational Psychology, (February, 1926), 17:2.
15. Isaacs, E., "Nature of Rhythmic Experiences," Psychological Review, 1920, pp. 270--300.
16. Johnson, Palmer O., Statistical Methods in Research, Prentice-Hall, Inc., New York, 1949.
17. Jones, Ruth W., and Margaret DeHaan, Modern Dance in Education, Bureau of Publications, Teachers College, Columbia University, New York, 1947.
18. Klauer, Neomi J., The Effect of Training upon Rhythm Discrimination in Intermediate Grades, Master's Thesis, State University of Iowa Library, Iowa, 1924.
19. Kwalwasser, Jacob, Exploring the Musical Mind, Coleman-Ross Company, Inc., New York, 1955.
20. Kwalwasser, Jacob, Tests and Measurements in Music, C. C. Birchard and Company, Boston, 1928.
21. Kwalwasser, Jacob and Peter W. Dykema, Music Tests, Carl Fischer, Inc., New York, 1930.
22. Lehman, Charles F., A Study of Musical Style Recognition, Unpublished Master's Thesis, Delta State College, Cleveland, Mississippi, 1956.
23. Lockhart, Aileene, Modern Dance: Building and Teaching Lessons, William C. Brown Company, Dubuque, Iowa, 1951.
24. Mamoulian, Reuben, "Rhythm, Music, and the Theater," Etude (April, 1945), 63:187 pp.
25. Mason, Bernard and Elmer Mitchell, The Theory of Play (Revised Edition), A. S. Barnes and Company, New York, 1948.

26. McCloy, Charles H. and Norma D. Young, Tests and Measurements in Health and Physical Education, Appleton-Century-Crofts, Inc., New York, 1954.
27. Peatman, John G., Descriptive and Sampling Statistics, Harper & Brothers, New York, 1947.
28. Radis, Ruth A., Modern Dance for the Youth of America, A. S. Barnes and Company, New York, 1944.
29. Redfield, John, Music: A Science and an Art, Alfred Knopf, New York, 1941.
30. Reilly, Catherine F., "Fun with Rhythm," Etude (July, 1952), 70:20.
31. Revelli, William D., "To Beat or Not to Beat," Etude (June, 1955), 73:19.
32. Revelli, William D., "What about Rhythm?" Etude (May, 1955), 73:19.
33. Roeder, Carl M., "How Important is Rhythm?" Etude (September, 1947), 65:500 pp.
34. Rucknick, Christian, "Role of Kinesthesia in Perception of Rhythm," American Journal of Psychology (April, 1924), 24:35.
35. Sacks, Curt, "Rhythm and Tempo: An Introduction," Musical Quarterly (October, 1938), 38:384--396.
36. Schuler, George S., "Master Rhythmical Problems at the Table First," Etude (October, 1945), 63:556.
37. Seashore, Carl E., Measures of Musical Talent, C. H. Stoelting Company, Chicago, 1926.
38. Seashore, Carl, Psychology of Music, McGraw-Hill Book Company, Inc., New York, 1938.
39. Seashore, Carl, The Psychology of Musical Talent, Silver Burdett and Company, New York, 1919.
40. Shambaugh, Mary Effie, The Objective Measurement of Success in the Teaching of Folk Dancing to University Women, Unpublished Doctoral Dissertation, University of California, 1935.

41. Stanton, Hazel M., Measurement of Musical Talent, Unpublished Master's Thesis, University of Iowa Studies, Iowa City, 1935.
42. Stupp, Lillian L., A Correlation of Musical Ability and Dancing Ability, Unpublished Master's Thesis, University of Wisconsin, 1922.
43. Sutherland, Eileen, "Accompaniment for the Dance," Unpublished Paper read at a meeting of the Boston Dance Council, December 12, 1943.
44. Thompson, Betty Lynd, Fundamentals of Dance and Rhythm, A. S. Barnes Company, New York, 1933.
45. Waterman, Elizabeth, The Rhythm Book, A. S. Barnes Company, New York, 1936.
46. Wert, James E., Charles O. Neidt, and J. Stanley Ahmann, Appleton-Century-Crofts, Inc., New York, 1954.
47. Whistler, Harvey S. and Louis P. Thorpe, Musical Aptitude Test, California Test Bureau, Hollywood, California 1950.