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Analysis of Generality and Specificity of Kinesthetic Performance in Gross Motor Skills.

Garland F. Pinholster
Louisiana State University and Agricultural & Mechanical College

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ANALYSIS OF GENERALITY AND SPECIFICITY OF KINESTHETIC
PERFORMANCE IN GROSS MOTOR SKILLS

A Dissertation

Submitted to the Graduate Studies Committee of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Education

in

The Department of Health, Physical and
Recreation Education

by
Garland F. Pinholster
B.S., North Georgia College, 1949
M.A., Peabody College, 1956
May, 1968
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The writer is indebted to Dr. Jack K. Nelson for his untiring efforts in directing this study.
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ABSTRACT

The purpose of this study was to analyze generality and specificity of kinesthetic gross motor performance and gross motor performance with full vision in the skills of hitting, throwing, passing and kicking.

Subjects for the study were 100 male Louisiana State University undergraduate students. All subjects were enrolled in regularly scheduled physical education activity classes. Subject ages ranged from eighteen to twenty-nine.

A review of the literature revealed an overwhelming amount of evidence for specificity of task performance. However, no investigations were reported that attempted to study the question of generality versus specificity of gross motor performance when performed kinesthetically. No studies were found that had utilized the gross motor skills involving throwing, hitting, kicking and passing of a ball.

Twenty subjects were tested in a pilot study to determine reliability and testing procedures. After minor revisions, the final study was conducted during the second semester of the school year 1967-1968.
One hundred subjects were tested in hitting, throwing, passing and kicking of a ball to a target of six concentric circles. Target values ranged from zero to six. Kicking and hitting were performed from a distance of thirty-eight feet while passing and throwing were done from a distance of forty-two feet. A soccer ball was used for kicking and passing, a tennis ball and paddle ball racquet for hitting, and a softball for throwing.

Subjects were tested on each skill in three ways. Ten trials were given for each of the three performance methods. Each subject performed blindfolded with auditory feedback, blindfolded with visual feedback, and with full vision. Counterbalancing of test events and feedback systems was utilized as a learning control measure.

Zero order correlation was employed to study the extent of generality or specificity of performance in the different tasks and the various methods of performing. Factorial design was utilized to compare performances in different motor skills, to compare kinesthetic performance with visual feedback; and to determine the effects of interaction between type of feedback and type of motor skill.

The main findings were:

1. More generality was revealed when gross motor skills involving use of a ball were performed with full vision than when performed blindfolded.
2. There is less generality of kinesthetic performance with only auditory feedback than there is when visual feedback is administered.

3. In total performance, the least generality and poorest scores were found in kinesthetic performance with auditory feedback.

4. Of the four motor skills, kicking resulted in the poorest performance and appeared to be the most task specific.

The conclusion was:

Apparently, full concurrent visual cues produce the most generality and the best gross motor performances with a proportional lessening of generality and skill as visual feedback is reduced.
CHAPTER I
INTRODUCTION

Statement of the Problem

Education in general is based upon the assumption that abilities and acquired knowledge can be transferred for practical use in many situations during life. Parents utilize this premise in the home training and teaching of their children. The so-called classical college curriculum and even graduate education proceed as though transfer was the absolute omega of most learning. Much education of the physical, e.g. teaching of gross motor skill fundamentals, is based on such a premise. The premise may be ill founded in each of these cases. This study was directed toward acquisition of additional insight into the question as it relates to physical development.

The problem of generality or specificity is complicated by overlap between learning and performance. It was recognized that some learning was involved in scores of performers in this study. One factor of learning was measured in the study. The subjects received visual and verbal feedback during kinesthetic performance. The two methods were compared.
Many of the studies have dealt with fine motor skills involving ability to reproduce a position with one limb. Others have utilized movements seemingly far removed from skills actually taught in physical education today. Thus this study attempted to develop tests of skills involving the use of a ball, such as hitting, throwing, passing and kicking.

The relationship of kinesthesia to motor ability has been studied primarily through static skills not highly related to dynamic athletic movements.

The majority of studies dealing with kinesthetic after-effects have utilized tactual-manipulative activity rather than tasks involving movements of the entire body and/or of large muscle groups. However, it is common in the gymnasium or athletic field to experience after-effects which arise from gross action patterns.¹

This study was addressed to the following questions as they relate to the problem of generality or specificity of motor task performance. (1) Is there a generality of abilities in hitting, throwing, passing and kicking skills? (2) Is there generality or specificity of ability in kinesthetic performance of hitting, passing, throwing and kicking skills utilizing verbal feedback? (3) Is there generality or specificity of ability in kinesthetic performance of

hitting, passing, throwing and kicking skills utilizing visual feedback? (4) Is visual or verbal knowledge of results more conducive to the kinesthetic performance of the motor skills of passing, throwing, hitting and kicking?

Purpose of the Study

The purpose of this study was to analyze generality and specificity of kinesthetic gross motor performance and gross motor performance with full vision, in hitting, passing, throwing and kicking skills.

More specifically the purposes were: (1) To determine the extent of generality or specificity of gross motor performance in hitting, passing, throwing and kicking skills. (2) To determine the amount of generality or specificity of kinesthetic gross motor performance in these skills utilizing verbal feedback. (3) To determine the amount of generality or specificity of kinesthetic gross motor performance in these skills utilizing visual feedback. (4) To compare the results of verbal and visual feedback administered during kinesthetic gross motor performance.

OVERVIEW

Physical educators may be guilty of subscribing to the popular view or trend. The history of any culture or field of endeavor reveals evidence of trends. What is
current becomes history in short order. Ideas that are initially more radical often evolve into the current vogue. It is just possible that this is the case with regard to the question of generality versus specificity. It may well be that the generality hypothesis is not examined carefully, honestly and objectively because it is not currently popular.

A full study of motor ability would probably coincide with other educational disciplines. Willgoose\(^2\) averred that motor performance is related to numerous characteristics of human behavior because the organism acts as a whole and that its general level of ability is exhibited in a variety of ways.

The Total Person

Aristotle is often given credit for having been the first proponent of generality of conditions between mind and body. However, Homer,\(^3\) who preceded Aristotle by several hundred years, is quoted in a debate with Hesiod, when asked what he considered the greatest good, as having said, "a sound mind in a manly body."


More recently in our modern culture, industry has begun to recruit the "well-rounded" individual. Personnel selections are made on the basis of balance in physical, intellectual and personality traits. Such broadly developed and educated individuals are then trained for their specific duties.

Both Homer's ancient thesis and industry's modern concept seem to indicate an automatic coalition, or generality, of abilities. Current research does not support this relationship between the mental and the physical. Slusher's study concluded that mental activity and physical prowess are not significantly related. Oxendine found that general intelligence scores were not related to learning or performance ability in four skills he tested. Other studies revealed no significant relationship between physical and mental performance.


These reports seem to indicate that high intelligence and physical prowess are combined in a single individual more through chance than for any other reason.

Generality of Mental Performance

What of generality of abilities that are considered within the realm of mental or verbal skill? College admissions directors regard the value of scholastic aptitude scores in relationship to their particular type of college. A technical college may readily admit a student with a mathematics score of 700 and a verbal or English score of 350. Such extremes are rare but do occur. The liberal arts college would prefer to have the weight of these scores reversed with the student more talented in communication. Such a policy of college admissions infers that within the scope of mental aptitude, a specificity of the task to be accomplished does occur.

Generality of Motor Performance

Physical educators are primarily concerned with the question of generality or specificity as it applies to physical skills. If a person is outstanding in handball, will he be able to perform well in squash? All teachers of physical education have heard about the "naturally coordinated" athlete who could perform any physical skill well
with little or no practice. Do such "naturals" exist? If so, the bulk of the research conducted up to this point does not reveal this. Some researchers such as McCloy and Hollingworth isolated certain "basics" of motor skill and alleged that individuals possessing all of those basics in abundance could be expected to perform well in a number of skills. These early studies implied a generality of motor ability.

Later studies have concluded a specificity of task performance. Notable among these studies are those offered by Seashore, Henry, Bachman and Lotter.

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Guilford\textsuperscript{14} developed a series of factors both psychological and physical to produce a matrix that would indicate the possessor as an individual of general ability.

**Kinesthesia and General Motor Ability**

Studies have been made to relate myriad physical and mental qualities to generality of motor ability. Some have even combined these qualities.

Cratty\textsuperscript{15} suggested that "further exploration of dynamic kinesthetic sensitivity" seems needed. Possibly this "sixth sense" of the performer will prove to be the vital element that the all-around or "natural" athlete must possess.

In one report McCloy\textsuperscript{16} listed sixteen factors which enhance the ease with which an individual may acquire motor skill—motor educability. He listed general kinesthetic sensitivity and control as item 8 and balance factors as item 12.

\footnotesize

\textsuperscript{15}Bryant J. Cratty, \textit{Movement Behavior and Motor Learning}, \textit{op. cit.}, p. 112.


\textsuperscript{17}Carl E. Willgoose, \textit{op. cit.}, p. 250.
In spite of numerous studies, kinesthesis is not fully understood either psychologically or physiologically. It is variously called the sixth sense, the motor sense, the balance sense, and proprioceptive sense. No matter how it is labeled, most researchers leave an open door regarding definitive statements concerning its components and source of stimuli.

Scott\textsuperscript{18} summarized the physiologists' statements concerning the location of receptors as (1) the muscle spindles around the muscle fibers; (2) the Golgi corpuscles in the tendons; (3) the Pacinian corpuscles in tendons and articular cartilage of joints; and (4) free nerve endings in the muscles, tendons and joints. These receptors are stimulated by tensions or pressure. The vestibular apparatus\textsuperscript{19,20} is helpful in maintaining balance and interpreting both lateral and horizontal movements.

Smith\textsuperscript{21} theorized that the ganglion brain cells are responsible for both response control of stimuli and learning.

\begin{itemize}
  \item \textsuperscript{20}Gladys Scott, \textit{op. cit.}, p. 326.
\end{itemize}
He further theorized that kinesthesis may be more aptly labeled somesthesis. Somesthesis indicates a bilateral pattern of response on the two sides of the body after stimulus from either of the two sides of the body. He based his theory of somesthesis partly on results of investigations of bilateral transfer of learning.

Christina\(^{22}\) listed five components of kinesthesis: (1) arm positioning in the vertical and horizontal plane, (2) leg positioning, (3) awareness of force and extent of muscular contraction, (4) balance, and (5) orientation of the body and its parts in space.

Feedback and Kinesthetic Motor Performance

Learning is a complex phenomenon resulting from the interaction of numerous elements of physiological, psychological and anatomical nature. This study will restrict its focus to one factor of learning variously termed knowledge of results, reward, reinforcement and feedback.

Feedback is error information designed to improve subsequent performance. It may be of the intrinsic or augmented type. Robb\(^{23}\) considered the augmented type to be generally


given by the instructor or experimenter, and the intrinsic form of feedback to be inherent in the task and derived from kinesthetic or proprioceptive sense or "feel."

Feedback may be considered as the third part of a chain action involving receptor and effector stimulus and response. Feedback is designed to improve, regulate, or control future action by receptor and effector mechanisms. The effector mechanism is composed of the organs and glands. The receptor mechanisms are generally thought of as the five senses of touch, taste, vision, smell and hearing. To these the writer would add a sixth, the kinesthetic sense.

Feedback may be given auditorially or visually. The normal teaching process involves the use of both verbal and visual feedback. Lockhart summarizes these methods of communicating with learners thusly: (1) verbal and visual feedback are probably not of equal significance; (2) they are probably the result of varying motivations; and (3) varying types of instruction are probably more or less meaningful at different stages for the learner.

In this study, verbal feedback will be offered by the researcher or an assistant. The performer will also be allowed to hear the sound of the impact of the projectile

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with the floor and thus form some judgment of distance and performance through kinesthetic "augmented" feedback.

Visual feedback may be offered by demonstration or by allowing the performer to see the result of his effort. This study will deal only with visual feedback by the performer.

Twitmeyer\textsuperscript{25} declared that performers who were visually guided were more stable and superior in performance. He was referring to learning situations that allowed performers to see the total act. In the kinesthetic phase of this study the performers will be allowed to see results of their efforts after the act, which will be performed blindfolded.

Definition of Terms

\textit{Generality of motor ability}. The ability of perform a number of motor skills well as a result of inherent ability.

\textit{Specificity of motor ability}. Motor ability or skill that is specific to the task being performed.

\textit{Kinesthesis}. The ability to sense direction and propel an object through use of internal cues during performance of a gross motor skill without concurrent visual feedback.

Verbal feedback. Augmented terminal knowledge of results of subject's performance verbalized by the experimenter.

Visual feedback. Extrinsic terminal visual knowledge of subject's kinesthetic performance.

Limitations of the Study

The study restricted its efforts to skills involving the use of a ball. Obviously, many excellent physical activities were not represented.

No standard measure of kinesthesis has thus far been found. The validity of kinesthesis tests in this study was accepted as face validity, i.e., kinesthetic cues are brought into play during performance of any activity without visual monitoring.

Kinesthetic sense is used in ways other than through restriction of vision. This study limited itself to the search for kinesthetic ability motivated by absence of vision.
CHAPTER II

REVIEW OF THE LITERATURE

The literature pertaining to this study was presented in four categories. Some studies indicate the presence of generality of motor skill, others insist on specificity of task performance. Thus, it seems logical to use this natural cleavage as a source of organization. The other categories were: literature dealing with kines-thesis, and literature concerning knowledge of results. No attempt was made to present all the writings in each of these four areas. However, the studies offered were found to be most closely related to this study.

STUDIES SUPPORTING THE PRESENCE OF

GENERALITY OF MOTOR ABILITY

Some reputable physical educators have produced what must be assumed as honest results to indicate the presence of generality of motor ability.

In 1913, Hollingworth\(^1\) concluded that practice was the vital ingredient of generality. His research revealed that more practice produced more generality of motor skill.

\(^1\)Hollingworth, op. cit., p. 412.
Thus, general ability was equated with final capacity rather than with momentary performance.

In 1934, McCloy\(^2\) published a test purported to measure general innate motor potentiality. He explained the word "general" as indicative of measurable motor capacities that were fundamental to almost all motor performance. He did not attempt to measure specific skills and abilities. Although each of the tests was representative of a certain definite and specific capacity, McCloy stated that "these specific capacities added together make up the mosaic of the total general capacity." The author also offered a test of general motor ability designed to measure achieved ability rather than potential ability.

Gire and Espenschade\(^3\) attempted to relate three tests of motor educability to learning of specific motor skills. It was found that all the tests were roughly accurate in predicting high and low group levels of ability attained over a period of time. However, they concluded that none of the tests precisely measured the ease with

\(^2\)McCloy, op. cit., p. 456.

which subjects learned or relearned skills in basketball, volley ball, and baseball in physical education classes.

One writer advanced the theory that transfer of skill will not occur unless the subject is aware of the ultimate goal while practicing for transfer. Woodward did not find this necessary in her investigation of transfer of training of textile workers. She found transfer between two tasks representative of industrial work when training was given in another task. The subjects were not aware of the purpose. She concluded that transfer was probably due to the similarity of the tasks.

Crafts studied transfer utilizing a card sorting task. His aim was to determine the degree to which similarity (common elements of two tasks) would affect transfer from training to a test situation. He found transfer positive and in proportion to the number of common elements deliberately injected into the two performances.

Guilford offered a similar study which agreed that certain skills were relevant to specific abilities, e.g.,

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7J. P. Guilford, op. cit., p. 163.
strength, coordination, flexibility and precision. However, he believed that a number of skills with a certain prerequisite (strength, for instance) could be expected in the possessor of that prerequisite.

Most of the literature supports a hypothesis of specificity of mental ability and physical ability. Goss and Greenfeld⁸ experimented with motor skill acquisition of tasks requiring stimulus similar to that used in verbal pretraining. Seven conditions of verbal discrimination were used in the study. The motor task involved learning lever positioning and the cues were related to prior verbal learning. In virtually all of the cases, a positive transfer was evident.

Oxendine⁹ found no transfer effects between two fine motor skills but he found evidence of generality between the learning of two gross motor skills. No transfer occurred between fine and gross motor learning. He used fine motor skills of mirror tracing and pencil maze. The two gross motor skills were disc tossing and a hop-scotch type skill.

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⁹Oxendine, op. cit., p. 93.
One recent search for generality gave an indication of general transfer from one skill to another. It was submitted by Nelson\textsuperscript{10} at Utah State University. His purpose was to study transfer of learning in gross motor skills which were somewhat similar. The problem was approached by (1) determining the amount of transfer between two skills that are somewhat similar when both are learned at the same time; (2) determining the amount of transfer between two similar skills when they are learned at separate times; (3) determining the extent of a possible transfer of learning when one of the objectives is the purposeful teaching for transfer. Six paired skills were studied in the study. They were a badminton and tennis wall volley, a basketball tip and volleyball tap for accuracy, and a track and football stance. He concluded that: (1) the initial learning of the tennis skill seemed to aid in the learning of the badminton skill; (2) the initial learning of the basketball skill seemed to have had a favorable effect on learning the volleyball skill; (3) the initial learning of the track start seemed to aid the learning of

the football stance start; (4) the deliberate teaching for transfer seemed to have little effect on the learning of the different skills.

Cratty also compared gross and fine motor learning utilizing kinesthetic cues. Two groups of subjects practiced traversal of large and small mazes. The large maze group had to move the entire body through a maze fifteen feet long. The small maze group performed with a stylus on a similar maze pattern six inches long. After each group had performed twelve trials, three times per week for four weeks, the two groups exchanged problems, i.e. performance of fine or gross motor skill. Cratty concluded that the lack of resulting relationship in performance of the two tasks was due to a spatial factor which would cause performance based upon kinesthetic cues to be specific to the task. He did find some transfer effect which was attributed to unconscious learning. He also gave credence to the theory that human movements are similar only if they occupy identical spatial dimensions. This theory was advanced by Smith and Smader in an earlier study.


In a later treatise, Cratty\textsuperscript{13} compared four groups with regard to the rate of learning of a large maze to determine the influence of previous practice in three small patterned mazes. The three small patterned mazes were irregular in construction. Learning was equated with the time necessary to travel a maze. There was negative initial transfer from small to large maze learning where maze patterns were dissimilar. There was positive initial transfer when patterns were similar. Cratty theorized that the results of this study might open previous theories of specificity to criticism. He hypothesized that "a general factor involving the accurate utilization of space" may exist and recommended further research.

The optimum weight of projectile to use for practice in a search for maximum transfer of throwing skill was studied by Egstrom, Logan and Wallis.\textsuperscript{14} It has been suggested that certain learnings may occur at a subconscious level involving feedback and muscular adjustments of which the learner is kinesthetically unaware. Fifty-six subjects


in two groups threw balls with the non-preferred hand fifteen feet at a target. The two projectiles weighed two ounces and six and one half ounces. Both balls were twelve inches in circumference. Transfer from light to heavy projectile was significantly better. The heavy ball group demonstrated a significantly lower score when they transferred to the light ball.

STUDIES SUPPORTING THE PRESENCE OF SPECIFICITY OF MOTOR PERFORMANCE

Seashore\(^{15}\) conducted a study to determine the relationships of fine and gross motor skills. He used six fine and seventeen gross motor abilities. When fine motor skills were correlated with each other, no relationship was found. No relationship was found when gross motor skills were correlated. He also found that fine and gross motor abilities were not related.

The purpose of Lindeburg's\(^{16}\) study was to determine whether quickening exercises would improve speed in other muscular activities. Three muscular activities were used. A simple finger press, normal peg shifting, and modified

\(^{15}\)Seashore, *op. cit.*, p. 261.

peg shifting with lateral and vertical arm movement were utilized. He found that a significant transfer did not occur between the special quickening exercises and the three movements he studied. He judged that transfer is specific and occurs only when the practiced movements are identical.

The transfer of skill from one side of the body to the other was observed by Smith and Von Treba\textsuperscript{17} in their study of transfer and direction of movements. Hand and arm movements in set directions and patterns were practiced by subjects while these actions were recorded by the Universal Motion Analyzer. Manipulative movements showed a definite transfer. Travel movements showed a negative transfer effect. The bilateral transfer of skill from one hand to the other persisted for about one week.

Henry and Nelson\textsuperscript{18} conducted a study to determine interrelationships between learning and actual performance.

\textsuperscript{17} Karl V. Smith and Patricia Von Treba, "Dimensional Analysis of Motion: IV. Transfer Effects and Direction of Movement", \textit{J. Appl. Psych.}, Vol. 36 (October, 1952), p. 352.

in two groups of boys at ages ten and fifteen years. They found the younger boys to learn more slowly than the older boys. It was suggested that there was more task specificity in older boys. The final skill level of the older group was found to be more dependent upon initial skill rather than upon learning; whereas, learning was a more important element in the final skill of the younger age group.

Henry\(^{19}\) is one of the leading spokesmen for the specificity camp. One of his several contributions concluded that large muscle motor performances are as specific as small muscle motor performances.

Mathews and others\(^{20}\) found improved strength in both arms after a period of exercising only one arm with an ergometer. Significant increases of strength occurred in exercised and unexercised arms, although significant increase of endurance occurred only in the exercised arm.

Fleishman\(^{21}\) analyzed relationships between individual differences in positioning movements and static


reaction tasks required in piloting aircraft. The tasks involved moving various limbs to a specific point in space in which terminal accuracy of the response was measured. The static reaction tests required holding a limb steady while in a fixed position. He concluded that coordination in these kinds of abilities is highly task specific.

Bachman\textsuperscript{22} tested 320 subjects on the initial learning of two large motor skills. One task was stabilometer balancing and the other was a free style ladder climb. He found motor learning and performance to be task specific. There was a positive correlation of abilities in the two tasks for the six-to-eleven-year old boys. Ability in the two tasks was not positive when the total scores of all four age groups were correlated.

Lotter\textsuperscript{23} explored the maximal speeds of certain arm and leg movements such as the action of throwing a baseball or kicking a football. The results were compared to results of the same individuals on repetitive (cyclic) movements. He found that individual differences in making a fast movement were highly specific to the task.

\textsuperscript{22}Bachman, \textit{op. cit.}, p. 6.

\textsuperscript{23}Lotter, \textit{op. cit.}, p. 60.
Clarke and Henry\textsuperscript{24} examined the effect of exercise on certain muscles causing speed of movement. They used exercises that avoided the movements to be tested. They found no relationship between strength and speed of movement. It was found, however, that improved strength resulted in a corresponding improvement in speed of movement.

Cratty's\textsuperscript{25} three-factor theory of perceptual-motor behavior has some bearing on the question of generality versus specificity. Cratty listed general supports of behavior as a base, perceptual-motor traits as the middle, and task specifics as the highest order of ability in motor skill. The base includes persistence, aspiration, and ability to analyze as general characteristics. The middle ground involves general body assets such as strength, speed, and accuracy. The highest order or task specifics includes experience, practice, visual monitoring, spatial conditions, force requirements, and social conditions present. Cratty thus summarized that declarations of specificity or generality are indefensible.


Singer\textsuperscript{26} questioned the effects of initial degree of difficulty upon ultimate success in archery. Subjects comprising three groups practiced from distances of ten, twenty-five, and forty yards. Ultimate success was not affected by initial success which was greater at the shorter distances. Singer concluded that no definite assumptions could be made about transfer effects and degree of difficulty of first learned tasks.

Rivens\textsuperscript{27} observed the transfer effects of several learned tasks upon one. Most studies have dealt with the effects of one learned task upon attempts to perform another. He used a modified shuffleboard skill with the subject standing with his back to the target. Nine groups performing from varying distances exhibited only fleeting transfer effects. However, additional practice appeared to overcome whatever transfer effects that were evident. It was also found that several simple tasks revealed significant transfer effects to one difficult task, but one simple task did not appreciably transfer to one difficult task.

\begin{itemize}
\end{itemize}
STUDIES OF KINESTHESIS

In 1933, Taylor\textsuperscript{28} inspected the effects of kines-thesia on success or failure in basketball players. One group consisted of varsity players and another group was composed of men who had been cut from the varsity squad. Fourteen tests of kinesthesis were administered, most of them dealing with repositioning of a limb with the eyes closed after the same position had been assumed with the eyes open. Taylor concluded that successful basketball players have better kinesthetic judgment than unsuccessful basketball players.

Wettstone\textsuperscript{29} related tests of kinesthesis to gym-nastic ability. Kinesthesis tests were arm positioning and target pointing with the eyes closed. He found no appreciable correlation between kinesthetic and gymnastic ability.

Tests of kinesthesis and the relationship of kines-thesis to general motor ability were studied by Young.\textsuperscript{30}


Thirty-seven subjects were given nineteen tests for kines­
thesis. These tests were correlated with scores of General
Motor Ability. She discovered no significant relationship
between total scores of motor ability and kinesthesia.

Fisher\textsuperscript{31} related general motor ability and capacity
with kinesthesia. A test of general motor capacity, a
test of general motor ability, and a battery of kinesthetic
tests were administered to 125 high school girls. Low,
positive correlations resulted between balance test, kines­
thetic tests, general motor ability and motor capacity.
There was also found a high relationship between performance
of right and left feet on balancing tests.

Meday\textsuperscript{32} analyzed the effects of practice on kines­
thetic discernment. The following three measures of kines­
thetic discrimination were employed: (1) a bean bag toss

\textsuperscript{31}Rosemary Fisher, "A Study of Kinesthesis in Selected
Motor Movements", Master's thesis, University of Iowa, 1945,
p. 31.

\textsuperscript{32}Helen Meday, "The Influence of Practice on Kines­
thetic Discrimination", Master's thesis, University of Cal­
ifornia, 1949, p. 65.
to target, (2) a scale pressure repositioning test, and (3) the judgment of weight of different objects. It was discovered that practice did not affect kinesthetic ability to discriminate between weights, but that practice enhanced ability to toss accurately and reposition scaled pressure.

Roloff\(^3^3\) followed the study made by Young and investigated twelve tests (some of them Young's suggested batteries plus others offered by Scott) for reliability, validity and relationship to learning rate in college women. She found a high degree of reliability and validity, plus a positive relationship between kinesthesia and the Scott test of motor ability. The author inferred that kinesthetic sense was improved in some groups, but no significant relationship was found between kinesthesia and learning of bowling and tennis over eight weeks.

Henry\(^3^4\) attempted to find the relationship between kinesthetic perception and kinesthetic adjustment. Twelve


subjects performed two tests of kinesthetic adjustment, which consisted of two levels of pressure against a spring-loaded lever, and one test of kinesthetic perception involving response to externally produced pressure. He concluded a reasonably close correspondence between perception and adjustment.

Mumby\textsuperscript{35} utilized advanced and intermediate wrestlers as subjects to study the relationship of ability in that skill to kinesthetic awareness. As a single group, the wrestlers proved to be significantly more talented in kinesthetic muscular pressure tests than was a control group. However, there was not a significant difference in kinesthetic abilities of advanced and intermediate wrestlers. Arm position tests of kinesthesia failed to be significantly related to wrestling.

Phillips\textsuperscript{36} found a low but positive relationship between kinesthesia and early performance of two golf-like skills. He further stated that there is no justification for use of the phrase "general kinesthetic sensitivity and control" unless during reference to the sum total of many specific abilities.


Weibe 37 inspected the relative value of various kinesthetic tests and their relationship to athletic ability. He used fifteen varsity and fifteen non-varsity undergraduates as subjects. Each subject was tested on twenty-one different tests. He discovered no kinesthetic difference in favor of the athletes and no general kinesthetic sensitivity among either group.

The rate of learning bowling skills and kinesthesis sense were correlated by Phillips and Summers. 38 They gave 115 college women twelve arm positional pointing tests under blindfold conditions as measures of kinesthesis. The particular experimental design revealed the following: (1) Motor learning and kinesthesis were related; (2) Kinesthesis was more related to learning in the early stages of skill acquisition; (3) A real difference between preferred and non-preferred hands in kinesthetic perceptivity was found.

Scott 39 attempted to establish practical tests for measuring kinesthesis. She analyzed test quality and

interrelationships of tests. She concluded that kines-thesis is a highly specific function. Tests constructed on the basis of face validity yielded reliable results which were consistent from one sample to another. No single test proved valid enough to be used as a single measure of kinesthesia.

Estep related static balance and motor ability. She equated the static equilibrium to kinesthesia while recognizing that other factors were involved in balance with the eyes closed. Balance was measured by the Miles ataximeter. Motor ability of girls was designated subjectively by physical education staff members. The author concluded a positive relationship between static equilibrium and ability in gross motor activities.

Extent of muscular force is usually listed as one of the components of kinesthesia. Slater-Hammel investigated the use of an electronic device for measuring muscular exertion. This was done to neutralize the effect of tactual stimulation which is normally a factor in most

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tests of kinesthesis. Subjects attempted to exert a specific force through isolated contraction of the triceps brachi. The subjects were required to reproduce practice contractions. Varying groups (physical education majors, liberal arts majors, female liberal arts majors) tended to reproduce more than the practiced muscular force. There was no significant difference between groups or sexes in variable errors.

Kinesthesis and mental practice, and tests of kinesthesis were assessed by Start. Subjects mentally practiced a new skill for five minutes each day for six days. They then performed the skill which was a single leg upstart on the high bar (a gymnastic skill), on the day following the final mental practice. Subsequently, the same subjects were given the Wiebe Test of Kinesthesis. A comparison of the scores of the two performances revealed no relationship between the mentally practiced skill and kinesthetic ability. Start inferred that the kinesthetic tests were inadequate estimates because "the subjective awareness of position and movement in space is comprised of many highly specific abilities."

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In one study, Smith\textsuperscript{43} designated the traditional concept of kinesthesis (direct movement-generated sensory return from neuromuscular spindles, Golgi tendon organs and Pacenian corpuscles) as the "reflex-circle doctrine." He suggested a new term—"somesthesis"—as a more accurate label. According to his hypothesis, "the most critical mechanisms of kinesthetic feedback control are based on direct neural detection of sensory differences between corresponding muscle stimulus loci on the two halves of the body." Smith proposed that studies of bilateral transfer of learning represented evidence of the validity of his theory of somesthesis.

Norrie\textsuperscript{44} looked for various kinesthetic abilities within individuals and between individuals. Her tests were essentially the repositioning of arms and legs, both left and right, with varying weights being lifted each time. She found that ability was highly task specific and that more differences existed within than between individuals.


LaBarba\textsuperscript{45} sought to determine the relationship between tactile and kinesthetic stimuli. Low electrical shock was used to measure tactile response while reproduction of dot-dash rhythms of a telegraph key was considered kinesthetic response. He found a strong relationship between scores of kinesthetic and tactile response. He also found that athletes of various age groups (other than high school age) scored higher on kinesthesia than on tactile responses. However, there was no difference between subjects of various backgrounds on tactile response.

Christina\textsuperscript{46} attempted to develop a single test for kinesthesia. He utilized a side arm position and repositioning minus vision as a test. He found the test reliable from day to day. The non-dominant hand yielded more precise test performance. Accuracy was improved when larger angles between the arm and body were utilized. Test performance was more proficient after a ten-day period of practice.

In a later article Christina\textsuperscript{47} summarized the contribution of kinesthesia to movement learning in the following manner:


An individual learns a new skill from the memory of former situations and the consciousness of present ones which help him to judge the correctness of his movements.

STUDIES OF GROSS MOTOR LEARNING
RELATING TO FEEDBACK

Feedback may be visual, verbal, kinesthetic or any combination of these. Feedback may serve one or all of several purposes. Robb\textsuperscript{48} summarized the roles of feedback as motivation, regulation, and/or reinforcement.

Smode\textsuperscript{49} concluded that additional feedback or information that forced the learner to concentrate on one particular item of the task increased learning through motivation. Lawther\textsuperscript{50} stated that best learning is the result of precise and prompt feedback for it is the modifier of further response.

Smith\textsuperscript{51} used the term "sensory cybernetics" to designate development of perception through integrated movement control of receptor function, stimulus selection,

\textsuperscript{48}Margaret Robb, \textit{op. cit.}, p. 39.


\textsuperscript{50}John D. Lawther, "Directing Motor Skill Learning," \textit{Quest}, Mono. 6 (May, 1966), p. 73.

\textsuperscript{51}Smith, \textit{op. cit.}, p. 48.
and afferent processes. In his cybernetic approach, feed-
back factors determine learning and its related functions
through direct sensory movement effects.

Drowatsky\textsuperscript{52} conducted a study to measure the im-
pact of perceived objects on subsequent experiences with
different sizes of objects. He pointed out that a person's
perceptions reflect his past experiences with the environ-
mental stimuli. Fifteen male students were shown fifteen
different sized squares without the subjects' being able
to observe the squares as they were changed. The subjects
tended to evaluate each square in size in terms of the one
previously observed. Motor ability was measured through
the use of eight motor skills. The author's verdict was
that perceptual organization and motor skill develop con-
committantly.

Pierson and Rasch\textsuperscript{53} investigated the effect of knowl-
edge of results on isometric strength scores. They found
isometric scores greater when the subject had a knowledge
of performance results.

\textsuperscript{52}John N. Drowatsky, "Relationship of Size Constancy
to Selected Measures of Motor Ability," \textit{Research Quarterly},

\textsuperscript{53}William R. Pierson and Philip J. Rasch, "Effect of
Knowledge of Results on Isometric Strength Scores," \textit{Re-
Smode\textsuperscript{54} compared performance and learning under two levels of feedback. A tracking task was devised and subjects in different groups were given high or low level information regarding results of their performances. Transfer effects of the two levels of feedback were also observed. Performance, learning, and transfer were better under conditions where knowledge of results was offered most completely.

Morford\textsuperscript{55} studied the effects of two amounts of supplementary visual feedback on kinesthetic learning. Ninety subjects divided into three groups received (1) kinesthetic feedback only, (2) kinesthetic and visual feedback, (3) and an even greater amount of visual feedback while performing a task of lever pressure control. His subjects achieved no appreciable learning utilizing kinesthetic feedback alone. The larger amount of feedback that was supplementary to kinesthetic feedback was found to be generally more effective.

Ellis\textsuperscript{56} tested forty-eight junior high school girls on the standing broad jump and grip strength. One group

\textsuperscript{54}Smode, op. cit., p. 303.


performed without knowledge of results and one group received knowledge of results. The groups did not prove to be significantly different according to her apodosis.

Cratty\textsuperscript{57} noted that kinesthesia is valuable as a factor in feedback. He also stated that the awareness of a limb's starting position prior to beginning a ballistic action is probably dependent upon kinesthetic feedback. Cratty expressed the belief that this sensation is more important in slow movements.

Battig\textsuperscript{58} compared the effects of verbal, visual, and kinesthetic cues on acquisition of lever positioning skill. The subjects adjusted an airplane type "joystick" in response to lights, no lights or called numbers. He found that practice involving verbal, visual, and kinesthetic cues was superior to practice utilizing only one cue.

Greenspoon and Foreman\textsuperscript{59} found that the time interval between performance and feedback was significant. They

\begin{itemize}
    \item \textsuperscript{57}Bryant J. Cratty, \textit{Movement Behavior and Motor Learning}, \textit{op. cit.}, p. 110.
    \item \textsuperscript{59}Joel Greenspoon and Sally Foreman, "Effects of Delay of Knowledge of Results on Learning a Motor Task," \textit{J. Exp. Psych.}, Vol. 51 (1956), p. 228.
\end{itemize}
concluded that best learning was achieved through immediate knowledge of results.

Gagne and Fleishman alluded to the presence of internal kinesthetic cues. They stated that the novice would spend more time in checking stance and alignment than would the more skilled performer who through habitual performance has sorted out valid and meaningful cues.

Gibbs conducted an experiment to determine the effects of continuous and intermittent kinesthetic feedback. Ninety-five subjects performed two types of lever tracking tasks. One involved isotonic movement with intermittent kinesthetic feedback and one involved isometric contractions of a continuous nature. He concluded that where continuous kinesthetic feedback existed, the best learning would result.

SUMMARY OF LITERATURE

Early studies indicate the presence of a generality of motor ability. Most of the authors of such studies

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qualified their conclusions by identifying the generally gifted motor person as one possessing a number of highly regarded athletic traits such as speed, strength, etc.

More recent studies tend to conclude a specificity of task performance. The influence of practice does not seem to have been measured adequately. The influence of practice may produce more generality of motor skill or it is possible that those studies concluding generality were produced by subjects who could learn quickly. At the present there does not appear to be a definite answer to the question of generality versus specificity, which should lead to more research concerning the question.

The study of generality must begin with a definition of the word. Some authors seem to have considered general ability as completely inherent, innate, or "natural" ability. Other researchers appear to be referring to educability when writing about generality. "General" motor ability tests apparently measure specifically achieved skills that combine to create the mosaic of total motor ability.

The study of transfer is interwoven in a study of generality. What one may conclude as generality may actually represent transfer. Transfer has been found to be positive when attempts were made to learn a new skill that was similar to a previously acquired skill. Such transfer is probably proportionate to the number of common elements inherent or injected into the two tasks.
Feedback has been categorized variously as visual, verbal or kinesthetic. Researchers' conclusions vary in weight or value of each to the motor learning process. All agree that feedback is vital. Practice is important in learning but the key to effective learning appears to be practice plus feedback information.

There is some contradictory evidence regarding the relationship between kinesthesis and motor learning and between kinesthesis and motor ability. It would appear that much research is still needed to determine the role of kinesthesis in gross motor performance.

Cratty stated that more research is needed to determine whether there are general or specific factors controlling the nature and function of kinesthesis and how kinesthesis integrates with other cues to form a total perception of movement. He called for the study of activities utilizing the entire body and large muscle groups rather than tactual-manipulative activities heretofore used primarily.

Elsewhere Cratty stated that

skill specificity may hinge upon the use of vision when performing motor acts. Transfer seems more likely in tasks where vision is eliminated, than when vision accompanies complex coordinations. The

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62 Cratty, Movement Behavior and Motor Learning, op. cit., p. 111.

63 Cratty, Quest, op. cit., p. 7.
neurological evidence relating to the vast amount of the brain devoted to visual functioning, as well as the complexity of the visual cortex, supports the contention that visual-motor performance may be highly specific; while movements performed in the absence of vision may be more highly related. Cells in the fovea of the eye are represented in the brain at a 1:1 ratio, while muscle receptors are probably afforded no such liberal representation in the cortex.
CHAPTER III

PROCEDURES

I. OVERVIEW

One hundred male subjects were tested for kines
thetic gross motor ability in hitting, passing, throwing, and kicking skills. The same tests and procedures were administered to all subjects with the exception of counter-balancing feedback methods and test events. Three performance methods were utilized. The tests were performed kinesthetically with auditory feedback, kinesthetically with visual feedback, and with full vision. Ten trials were given for each of three performance methods. The order of kinesthetic feedback method was counterbalanced. In each test, subjects hit, threw, passed or kicked to a target of concentric circles marked on the floor. The subjects were blindfolded during the two kinesthetic performances. Scores were the sum total of values of target hits for each of the three methods of performing. Target hit values ranged from zero to six.

II. SELECTION OF SUBJECTS

One hundred Louisiana State University male undergraduate students served as subjects. About one half of
them were Health, Physical and Recreation Education students enrolled in the majors program. The other subjects were enrolled in activity classes. These classes were gymnastics, badminton, wrestling, conditioning exercises, tennis, weight training and golf. Subject ages ranged from eighteen to twenty-nine.

Motivation of Subjects

While all of the subjects were enrolled in classes in the Department of Health, Physical and Recreation Education, their participation was on a voluntary basis. Their status as volunteers was explained to them both by their instructors and the researcher. An attempt was made to secure the subjects' cooperation, interest, and motivation to perform at their best. They were told that the experiment was an attempt to find a factor that would be the key to all-around or general athletic ability. The subjects were promised a report on the results of the research.

III. PILOT STUDY

A pilot study was conducted during the month of December, 1967. Twenty subjects were tested. Subjects were Louisiana State University male undergraduates enrolled in activity classes in the Department of Health, Physical and Recreation Education.
Test of Motor Ability and Kinesthesis

Four tests were employed. The tests were designated as hitting, throwing, passing, and kicking. Through trial and error the researcher arrived at the distance that would be challenging for each event. Hitting and kicking were performed from a restraining line marked on the floor thirty-eight feet from the center of the target. It was decided that a greater distance was necessary for the overhand throw and the two-hand chest pass in order to adequately distinguish among different levels of ability. The restraining line for these two events was set at forty-two feet. The restraining lines were two inches wide and one foot long. They were marked with a combination of one inch of white adhesive tape and one inch of white tempera paint. Two restraining lines were marked for two stations so that two subjects could be tested simultaneously. The two stations were forty-four inches apart. The same tests were utilized to test for kinesthesis. In the tests of kinesthesis the subjects' vision was eliminated by placing opaque goggles over their eyes.

Cratty has urged more kinesthetic testing of large muscle groups and total body motion of a gross motor nature.

1Bryant J. Cratty, Movement Behavior and Motor Learning, op. cit., p. 111.
The four tests employed in this study were designed to meet those qualifications. In each test the skill involved propulsion of a ball. A ball is used in many of the sports taught in physical education classes in this country. The skills selected were not intended to represent all types of physical education activities, nor were they designed to represent all of those requiring propulsion of a ball. However, it was believed that the tests were fairly representative of American sports that require the use of a ball.

The tests measured accuracy in hitting, throwing, passing, and kicking. In each event, the ball was aimed at a target of concentric circles marked on the floor. The pilot study target had a center circle (highest value) that was three feet in diameter, with two outer circles nine feet and fifteen feet in diameter, respectively. The value of a hit in the center circle was five and the second and third circles were valued at three and one, respectively.

Target Used in Pilot Study

![FIGURE I. PILOT STUDY TARGET](image-url)
The twenty pilot study subjects were able to consistently score fives and threes on throwing and passing skills. In order to achieve greater variability in the scores for the actual study, it was decided to create six circles by halving each of the original ones. The dimensions and values of the target used in the actual study are given on page 51.

Number of Trials

Ten trials for motor ability with eyes open and ten trials for kinesthesis (no vision) were administered to each subject for each of the four tests. The tests for motor ability were given first in the pilot study.

An examination of the mean trends for the twenty subjects on each trial indicated the need for ten trials. In all but one event (passing) the subjects reached their peak performance before the tenth trial. The mean performance for all subjects is shown in Table I.

Reliability of Pilot Study Tests

Willgoose\(^2\) listed kinesthesis as one of ten elements of motor ability. Weibe\(^3\) defined kinesthesis as being

\(^3\)Weibe, *op. cit.*, p. 222.
position sense. Ragsdale\(^4\) wrote that blindfold practice enhanced dependence upon kinesthetic cues. Thus, it was that blindfold performance would be one way to test for kinesthesis.

**TABLE I**

<table>
<thead>
<tr>
<th></th>
<th>Means</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>G</td>
<td>K</td>
<td></td>
</tr>
<tr>
<td>Hitting</td>
<td>2.51</td>
<td>1.59</td>
<td>8.31</td>
</tr>
<tr>
<td>Throwing</td>
<td>4.33</td>
<td>2.93</td>
<td>4.48</td>
</tr>
<tr>
<td>Passing</td>
<td>3.68</td>
<td>2.69</td>
<td>9.1</td>
</tr>
<tr>
<td>Kicking</td>
<td>1.62</td>
<td>.902</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>G</td>
<td>K</td>
<td></td>
</tr>
<tr>
<td>Hitting</td>
<td>10.5</td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td>Throwing</td>
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<td>17</td>
<td>34</td>
</tr>
<tr>
<td>Passing</td>
<td>11.7</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>Kicking</td>
<td>7.6</td>
<td>21</td>
<td>25</td>
</tr>
</tbody>
</table>

G represents general motor ability and K is indicative of kinesthesis in Table I.

The reliability was tested by the split-half method. The correlations were then estimated by the Spearman-Brown prophecy formula. A considerable degree of reliability was found. r's of .67, .66, .71, and .70 were found for the general motor skills of throwing, hitting, passing and kicking. For kinesthesis, r's of .73, .86, .69, and .71 were found for the same skills.

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Relationship of Motor and Kinesthetic Tests

The total scores for all subjects' motor ability and the total scores of all subjects' kinesthesia tests were correlated in the pilot study. The r's found were .58, .57, .51 and .34 for throwing, hitting, passing and kicking, respectively.

IV. DESCRIPTION OF TEST EVENTS IN THE STUDY

Each subject performed all four tests without interruption. The order of the tests was counterbalanced. Each subject later assumed the role of "coach" and scorer.

Ten trials for kinesthesia were performed in two ways. One time auditory feedback was utilized and one time the subject performed ten trials for kinesthesia with visual feedback. Ten trials for each event were performed with complete use of vision as a test of motor ability. The first two methods were counterbalanced so that every other subject performed first with auditory feedback, and every other subject performed first with visual feedback.

Each subject performed thirty trials for each test. Thus a total of 120 trials were performed with no pause other than to secure goggles or projectiles for the next event.

Target

The target was marked on the floor. The center of the target was eighteen inches in diameter. Each of five additional circles was arranged eighteen inches from the outside
edge of each other in concentric fashion around the center of the target. Seven values were designated for the target area, from six (middle of target) to zero (complete miss).

The target circles were marked initially with one-inch wide strips of adhesive tape. After the adhesive tape circles were placed and measured for verification, they were widened to two inches by painting an additional one-inch white line around the outside edge of each.

FIGURE II.
TARGET FOR KINESTHETIC AND GROSS MOTOR TESTS
Hitting

The test of hitting ability was measured by having the subjects hit a tennis ball with a paddle ball racquet. Any grip or underhand swinging style was considered legal. To get the proper trajectory, subjects were asked to hit the ball over a beam that was ten feet above the floor. The following pictures illustrate kinesthetic and gross motor performance of the hitting test.

FIGURE III.

KINESTHETIC AND GROSS MOTOR HITTING
Throwing

The throwing technique called for a one-handed overhand throw. The subjects were required to throw so that the ball started upward when it left their hands. They were instructed to try to throw over the ten foot high beam running across the room. A softball was used as the throwing projectile. Any stance was allowed as long as the subject remained behind the restraining line. The following pictures illustrate kinesthetic and gross motor performance of the throwing test.

FIGURE IV.

KINESTHETIC AND GROSS MOTOR THROWING
Passing

A soccer ball was used to measure passing skill. A two-hand basketball chest pass or set shot technique was used. Subjects were instructed to attempt to pass the ball over the beam to get the desired parabola. Parallel or staggered stance was allowed. The following pictures illustrate kinesthetic and gross motor performance of the passing test.

FIGURE V.

KINESTHETIC AND GROSS MOTOR PASSING
Kicking

A soccer ball was used as the projectile. Any style of punting was allowed as long as the ball was kicked before it struck the floor. Some subjects used one step and some utilized two steps. Most subjects kicked with the instep or top of the foot striking the ball. Others utilized a soccer style kick with the side of the foot. Subjects had to stay behind the restraining line to kick the ball. They had to drop the ball from the hands toward the foot and kick it while it was still in the air.

FIGURE VI.

KINESTHETIC AND GROSS MOTOR KICKING
Validity

Validity of the tests was assumed at face value. The literature would seem to support this approach. Scott stated that "the face validity of the individual items was considered reasonable." She was referring to test items in a kinesthetic perception test battery. Elsewhere, she referred to kinesthetic perception as the connecting link between previous experience and learning a new motor task.

V. TESTS FOR KINESTHESIS

The same events utilized for testing motor ability were utilized to test for kinesthesia. The only difference was that the subject's vision was obstructed by opaque goggles.

Visual Restriction

The goggles used were aviator style and rubber edged, with opaque celluloid lenses. To insure the fact that subjects could not utilize their vision, adhesive tape was placed over the lenses of the goggles. Eye periphery rubber edges fitted snugly against the eyebrow and cheekbone of the subject so that no frontal or periphery vision was

5Scott, op. cit., p. 334.
possible. Subjects could see the floor directly at their feet. In no way could they see the target while performing in the required manner.

VI. FEEDBACK DURING KINESTHETIC TESTS

Auditory

During ten trials of each test event, subjects were allowed no visual knowledge of results. The only feedback they received was an auditory description of their performance given by their "coach". The "coach" used a clock-face method of describing where projectiles landed; for example, he might say, "in the two circle at five o'clock." The "coach" was allowed to tell the subject to turn left or right before the next effort. He was allowed to instruct verbally but could not touch or physically aid the subject unless it was necessary to reposition him behind the restraining line.

Visual

During ten trials, subjects were allowed to raise the goggles to see where the projectile landed. In the event, a subject did not raise the goggles in time to see the projectile land, his "coach" would stand on the spot to give him visual knowledge of the results of his performance.
VII. TESTING AREA

A room twenty feet wide and sixty feet long was used for the experiment. The room ceiling was slanted upward at a 45° angle from the right wall, which was eleven feet from the floor. Windows on the left wall and electric lights provided ample lighting. There was only one door to the room, which was kept locked during most of the final study so that the target and restraining lines could be kept intact. A beam ran across the center of the rectangular room between the target and performance lines at a height of ten feet. During each test, subjects were encouraged to hit, throw, pass or kick over the beam. Retrials were allowed when projectiles in good target trajectory hit either the beam or the lower part of the slanted ceiling.

No spectators were allowed during the course of the experiment. This was done so that the performers would feel no inhibitions, nor would they receive any special motivation from the presence of spectators.

VIII. TESTING PROCEDURES

Test Performance

Two subjects were tested at the same time. The two subjects subsequently served as coaches for two more subjects.
The two coaches for the first two subjects were never tested in order to avoid potential learning.

The subjects entered the room and filled out score card information. A score card is shown in Appendix A. Subjects were instructed briefly concerning the nature of the test and introduced to their coach who had in most cases already served as a subject. A brief demonstration of each event was given by the researcher. The instructions that were given to each subject are in Appendix B.

During the ten trials for kinesthesis with auditory feedback, the coaches were instructed to stand adjacent to their subjects. The researcher retrieved the projectiles after each trial and rolled them back to the coaches. The coaches handed the projectile to the subject, informed him of his results, and marked the value of the hit on the subject's score card. During the ten trials of kinesthesis with visual feedback and the ten trials of general motor ability with eyes open, the coaches stood at the target area. They rolled the projectiles directly to the subjects and marked the score cards with no assistance from the researcher.

Delay between trials was kept nearly uniform. The time lapse amounted to the time required for the scorer to mark the card and roll the ball back to the coach. That time was less than ten seconds.
Scoring

The score cards were mimeographed on cards with fifteen columns for marking. There were three columns for each event. The columns were for scoring kinesthesis with auditory feedback, kinesthesis with visual feedback, and for scoring general motor ability. There were three additional spaces for totaling each of the methods of performance.

Coaches marked the value of each hit immediately after the projectile landed. If a line was hit, the value of the highest adjacent circle was given. If the projectile missed the entire target, a zero was recorded. If a projectile that appeared to be on a trajectory to the target struck the beam across the room or the slanted ceiling, a retrial was given.

At the end of all the tests, each coach was asked to rewrite any digits that may later have appeared to be illegible. The score cards were then received by the researcher and two more subjects were brought into the room. The two subjects remained to perform as coaches and scorers for the next two subjects.

Time Utilized for Testing

Testing of subjects was performed primarily during the month of February, 1968. The hours between 7:30 and 9:00 a.m. and 12:00 noon and 3:00 p.m. were utilized.
It required almost exactly thirty minutes to test one subject. However, the time for testing was expedited by arranging two stations so that two subjects could perform at the same time. Organization, preparation, and administration of the tests for four subjects normally required three hours. Thus, approximately seventy-five total hours were utilized in testing 100 subjects.
IX. ANALYSIS OF DATA

Correlations were computed to determine relationships among the three types of performances in each task: kinesthetic performance with auditory feedback, with visual feedback, and performance without blindfolds. Correlations were also drawn among the four tasks to determine the relationship of ability from one skill to another for each of the three performance techniques.

A factorial analysis of variance was employed to investigate the differences among the four motor skills, the difference between kinesthetic performance with auditory feedback and visual feedback, and the interaction effects of feedback and motor skill. Orthogonal comparisons were then utilized to locate the nature of the differences in cases where significant F ratios were found.
CHAPTER IV
ANALYSIS OF DATA

I. CORRELATIONS TO ASSESS GENERALITY OF THE VARIOUS METHODS OF PERFORMING IN THE FOUR GROSS MOTOR SKILLS

The data were first analyzed to determine the relationship of method of performing among the gross motor skills of hitting, throwing, passing and kicking. Six correlations were drawn for each of the three performance methods. Table II indicates results of those correlations.

TABLE II
CORRELATIONS AMONG THE FOUR MOTOR SKILLS FOR KINESTHETIC PERFORMANCES WITH AUDITORY FEEDBACK AND WITH VISUAL FEEDBACK AND FOR PERFORMANCE WITH VISION OF 100 COLLEGE MEN

<table>
<thead>
<tr>
<th></th>
<th>AK</th>
<th>VK</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitting vs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Throwing 1-2.</td>
<td>.26</td>
<td>.01</td>
<td>1-2 .28 .01</td>
</tr>
<tr>
<td>Hitting vs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passing 1-2.</td>
<td>.27</td>
<td>.01</td>
<td>1-3 .29 .01</td>
</tr>
<tr>
<td>Hitting vs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kicking 1-4.</td>
<td>.03</td>
<td>NS</td>
<td>1-4 .26 .01</td>
</tr>
<tr>
<td>Throwing vs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passing 2-3.</td>
<td>.43</td>
<td>.01</td>
<td>2-3 .34 .01</td>
</tr>
<tr>
<td>Throwing vs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kicking 2-4.</td>
<td>.05</td>
<td>NS</td>
<td>2-4 .17 NS</td>
</tr>
<tr>
<td>Passing vs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kicking 3-4.</td>
<td>.17</td>
<td>NS</td>
<td>3-4 .26 .01</td>
</tr>
</tbody>
</table>

r needed for significance at .01 level = .25
1 = Hitting; 2 = Throwing; 3 = Passing; 4 = Kicking
AK = Kinesthetic performance with auditory feedback
VK = Kinesthetic performance with visual feedback
M = Motor performance with full vision
As shown in Table II, the kinesthetic kicking skill appeared to be quite specific in that this performance showed relatively low relationship with other skills. In performances using auditory feedback, the correlations were .03, .05 and .17 with hitting, throwing and passing, respectively. Kinesthetic kicking performance with visual feedback was found to relate slightly higher to the other three skills than did the auditory feedback performance. The coefficients of correlation were .26 for kicking and hitting and kicking and passing, and .17 between kicking and throwing.

The correlations of kicking performance to performances in the other tasks were considerably higher when performed with vision than when executed kinesthetically. Coefficients of correlation of .36, .40 and .45 were found between kicking and hitting, kicking and throwing, and kicking and passing, respectively. While these relationships were still too low for predictive purposes, they were many times higher than the coefficients obtained between kicking and the other motor skills when performed kinesthetically.

In this particular analysis it appeared that the hypothesis expressed by Cratty\(^1\) in the introduction was untenable. The hypothesis was that perhaps there would be more generality

\(^1\)Cratty, *Quest*, *op. cit.*, p. 7.
with eyes closed than with eyes open. It is immediately apparent that the opposite is true as shown by the relationships of kicking and hitting during kinesthetic performance \((r = 0.03)\) auditory feedback and \(0.26\) visual feedback and visual performance \((r = 0.36)\). For the same conditions, kicking and throwing correlated 0.05, 0.17 and 0.40. A somewhat different pattern is evidenced when the interrelationships among the other three motor skills are analyzed. The relationship between hitting and throwing was essentially the same kinesthetically with auditory feedback \((r = 0.26)\), with visual feedback \((r = 0.28)\) and when done with vision \((r = 0.26)\). Similarly, the correlations between hitting and passing were almost exactly the same under the three conditions of performance. The remaining relationship, between throwing and passing, was generally highest at each of the three conditions of performance. The two skills correlated 0.43 when performed kinesthetically with auditory feedback, 0.34 with visual feedback, and 0.41 with full vision.

The hypothesis mentioned above therefore was again found to be untenable since the relationships, or generality of performance, appeared to be the same under each condition of practice. However, it was shown that there was more generality among the three skills of hitting, throwing, and passing under the different conditions of performance than
between kicking and any of the other skills under the different conditions. As was perhaps expected, the generality of performance in throwing and passing was highest of all.

In summary, the intercorrelations among the four motor tasks under each of the three methods of performing in Table II shows that the highest relationships (generality) were obtained when performance was done with full vision. The least generality was found when the subjects were performing with least visual cues which was while blindfolded with only verbal knowledge of results. This finding contradicts the hypothesis that more generality would be found with eyes closed than with eyes open.

II. INTERCORRELATIONS OF PERFORMANCES WITH AUDITORY FEEDBACK, WITH VISUAL FEEDBACK, AND WITH FULL VISION

The data were next analyzed to determine the relationships of the three methods of performing in each motor skill. Thus, for each task the kinesthetic performance with auditory feedback was correlated with kinesthetic performance with visual feedback; then kinesthetic performance with auditory feedback was correlated with performance with full vision; and finally, kinesthetic performance with visual feedback was correlated with performance with full vision. The results of these correlations for each of the four gross motor tasks are shown in Table III.
TABLE III

INTERCORRELATIONS OF PERFORMANCE SCORES OF 100 COLLEGE MEN IN KINESTHETIC PERFORMANCE WITH AUDITORY FEEDBACK, WITH VISUAL FEEDBACK, AND PERFORMANCE WITH VISION IN FOUR GROSS MOTOR SKILLS

<table>
<thead>
<tr>
<th>Hit-</th>
<th>Throw-</th>
<th>Pass-</th>
<th>Kick-</th>
</tr>
</thead>
<tbody>
<tr>
<td>r</td>
<td>P</td>
<td>r</td>
<td>P</td>
</tr>
<tr>
<td>AK-VK</td>
<td>.46</td>
<td>.01</td>
<td>AK-VK</td>
</tr>
<tr>
<td>AK-M</td>
<td>.41</td>
<td>.01</td>
<td>AK-M</td>
</tr>
<tr>
<td>VK-M</td>
<td>.53</td>
<td>.01</td>
<td>VK-M</td>
</tr>
</tbody>
</table>

r needed for significance at .05 level = .19 N = 100
at .01 level = .25

AK - kinesthetic performance with auditory feedback
VK - kinesthetic performance with visual feedback
M - gross motor performance with full vision

Although the relationships for the majority of the correlations were statistically significant, none was high enough to be of predictive value. That is, the scores of a subject's performance while blindfolded and receiving verbal feedback would not be indicative of the subject's potential score in motor performance with full vision, and vice-versa. Generally, the relationships between normal performance with full vision and kinesthetic performance with visual feedback were higher than either the normal performance with full vision and kinesthetic performance with auditory feedback, or auditory feedback performance and visual feedback performance. The lowest correlations were found between kinesthetic performance with auditory feedback and gross motor performance.
The coefficients of correlation for task performance methods (Table III) proved to be considerably higher than the coefficients of correlation for task performances in the four gross motor skills. Thus, it appears that regardless of the motor skill performed, there tends to be a fairly high relationship among performances, whether kinesthetically or not in any particular motor task. If a subject performs well under kinesthetic conditions with verbal cues, he will be apt to perform well under kinesthetic condition with visual cues and with full vision.

The methods of kinesthetic performance utilizing different levels of feedback were more highly related for the skill of passing than for any other skill. The coefficient of correlation was .73 for kinesthetic performance with verbal feedback and kinesthetic performance with visual feedback. This may be attributed to the great emphasis on development of peripheral vision in sports where skill in passing is essential. Some almost blind passing is done in sports such as soccer, basketball and volleyball. On the other hand, the lowest coefficients were found for kinesthetic feedback technique for the skill of throwing. A coefficient of .30 was found between kinesthetic performance conditions with auditory and with visual feedback respectively. This may be attributed to the emphasis on full visual target concentration in such sports
as softball and baseball. This is further evidenced by the very low correlation between kinesthetic performance with verbal feedback and motor performance with full vision.

In summary, it can be assumed that gross motor performance scores with visual feedback are more highly related to scores produced with full vision. The two kinesthetic performance methods are individually more highly related to gross motor performance method with full vision than they are related to each other.

III. COMPARISON OF KINESTHETIC PERFORMANCE IN THE FOUR MOTOR SKILLS WHILE UTILIZING AUDITORY FEEDBACK AND VISUAL FEEDBACK

A factorial analysis of variance was employed to investigate the differences among the four motor skills, the difference between kinesthetic performance with auditory feedback and visual feedback, and the interaction effects of feedback and motor skill. Three part analysis of variance was used in order to account for the fact that the same subjects were given all of the treatments.

The results of that analysis are shown in Table IV.
### TABLE IV

**ANALYSIS OF VARIANCE OF KINESTHETIC PERFORMANCE SCORES OF 100 COLLEGE MEN ON FOUR GROSS MOTOR SKILLS UTILIZING AUDITORY AND VISUAL FEEDBACK**

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Among Subjects</td>
<td>24095</td>
<td>99</td>
<td>243</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>61497</td>
<td>3</td>
<td>20499</td>
<td>250</td>
<td>.01</td>
</tr>
<tr>
<td>B</td>
<td>15647</td>
<td>1</td>
<td>15647</td>
<td>191</td>
<td>.01</td>
</tr>
<tr>
<td>A x B</td>
<td>1840</td>
<td>3</td>
<td>610</td>
<td>7</td>
<td>.01</td>
</tr>
<tr>
<td>Error</td>
<td>56811</td>
<td>693</td>
<td>82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>155692</td>
<td>799</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*F needed for significance at .01 level with 3 degrees of freedom = 3.82*

*F needed for significance at .01 level with 1 degree of freedom = 6.67*

In Table IV it can be seen that significant F's were found for levels A, the effects of different motor skills; B, the effects of type of feedback; and A x B, the interaction of type of feedback and different motor skills.

The significant F found for A indicates that there were significant differences among the scores on the four motor tasks. Orthogonal comparisons were then made to determine where the differences in performance lay.

The significant F indicated for B in Table IV refers to the comparison between kinesthetic performance with auditory feedback and kinesthetic performance with visual feedback for
all subjects on all skills. The overall mean score for all four tasks performed kinesthetically with visual feedback was 31.31; the mean score for kinesthetic performance with auditory feedback was 22.46. The significant F indicates that performance with visual feedback was significantly superior to performance with verbal feedback in the gross motor tasks of hitting, throwing, passing and kicking, when these skills are viewed as a unit.

It was thus determined that there was a difference between overall kinesthetic performance with verbal cues and kinesthetic performance with visual cues. The significant F for A x B indicates that this difference was not uniform or consistent throughout the four levels of skills. This F in itself does not reveal the nature of the inconsistency. Orthogonal comparisons were therefore made to determine where among the four motor skills that a significant deviation in the difference between verbal and visual performance occurred.

IV. ORTHOGONAL COMPARISONS FOR DIFFERENCES IN PERFORMANCE AMONG THE FOUR MOTOR SKILLS

It was determined by the Significant F for A that some tasks were performed kinesthetically more skillfully than others. Orthogonal comparisons were made in an effort to determine which skills were performed most efficiently when the scores for kines- thetic performance in the four motor skills were combined. Since there were four skills (or treatments), three comparisons were allowed (N-1). The results of the comparisons made are presented in Table V.
<table>
<thead>
<tr>
<th></th>
<th>Hitting</th>
<th>Throwing</th>
<th>Passing</th>
<th>Kicking</th>
<th>Variance</th>
<th>Mean</th>
<th>df</th>
<th>Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>30.62</td>
<td>36.45</td>
<td>27.77</td>
<td>12.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C₁</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-3</td>
<td>56,676</td>
<td>1</td>
<td>53,676</td>
<td>654.6</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>C₂</td>
<td>-2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>295</td>
<td>1</td>
<td>295</td>
<td>3.6</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>C₃</td>
<td>0</td>
<td>1</td>
<td>-1</td>
<td>0</td>
<td>7,526</td>
<td>1</td>
<td>7,526</td>
<td>91.8</td>
<td>.01</td>
<td></td>
</tr>
</tbody>
</table>

F needed for significance at .05 level = 3.94
F needed for significance at .01 level = 6.90

The first comparison (C₁) was significant at the .01 level. In this comparison, kinesthetic skill in hitting, throwing and passing was compared with kinesthetic performance in kicking. The significant F indicated that these subjects were more skilled in performance of the gross motor skills of hitting, throwing and passing than in kinesthetic ability to kick a ball. Such a result appears fairly logical when consideration is given to the emphasis in American sports on ability to hit, throw or pass a ball.

The second comparison (C₂) was made in a further attempt to determine which of the three skills already proven better than kicking was superior to the others. It was decided to compare hitting performance with throwing and passing skills. No difference was found when the skills were compared in this manner.
Lastly, kinesthetic gross motor performance scores in throwing and passing were compared. A significant difference at the .01 level was found in favor of throwing. Such a finding may be attributed to the vast number of sports in this country that emphasize throwing an object in some manner.

In summary, it appears that the subjects' poorest performances were in kicking. There was no difference when throwing and passing were combined with hitting. Throwing skill was better than passing, and it can be inferred that throwing was probably superior to performances in hitting, passing and kicking.

V. ORTHOGONAL COMPARISONS TO DETERMINE THE NATURE OF THE SIGNIFICANT INTERACTION BETWEEN AUDITORY AND VISUAL FEEDBACK WITHIN THE FOUR MOTOR SKILLS

It has already been determined that kinesthetic performance with visual feedback was significantly better than kinesthetic performance in the four skills with auditory feedback (see Table IV). The data were next analyzed to determine deviations from uniformity in difference between the two methods in the motor tasks of hitting, throwing, passing and kicking. Orthogonal comparisons were made to obtain information concerning the interaction, which is actually a difference between differences, between the type of skill and type of feedback for kinesthetic performance. The results of those comparisons are presented in Table VI.
TABLE VI

COMPARISON OF THE DIFFERENCES BETWEEN AUDITORY AND VISUAL FEEDBACK IN THE PRESENCE OF EACH OF THE FOUR MOTOR SKILLS FOR 100 COLLEGE MEN

<table>
<thead>
<tr>
<th></th>
<th>Hitting</th>
<th>Throwing</th>
<th>Passing</th>
<th>Kicking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diff.</td>
<td>869</td>
<td>1104</td>
<td>1169</td>
<td>396</td>
</tr>
<tr>
<td>Diff.</td>
<td>396</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Var.</td>
<td>10.56</td>
<td>246.9</td>
<td>1590.9</td>
<td>1590.9</td>
</tr>
<tr>
<td>DF</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Square</td>
<td>10.56</td>
<td>246.9</td>
<td>1590.9</td>
<td>1590.9</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>P</td>
<td>.12</td>
<td>NS</td>
<td>.01</td>
<td>.01</td>
</tr>
</tbody>
</table>

F needed for significance at .05 level = 3.94
F needed for significance at .01 level = 6.90

In comparison one, the difference between kinesthetic performance with auditory and visual feedback was found to be uniform in passing and throwing. In other words, visual feedback was uniformly superior to auditory feedback. Next, the differences between feedback systems were compared for hitting against the differences in throwing and passing. Again, the differences proved to be the same. Consequently, the advantage of visual feedback over verbal feedback was found to be uniform for the three skills of hitting, throwing, and passing.

However, when the differences between visual and auditory feedback for performances in kicking was compared with the other three skills, a significant F (C3) was found. This indicated that for kicking the difference was significantly less than in the other three skills. Presumably, auditory feedback
was as effective as visual feedback in kinesthetic performance of this particular skill test. In summary, the differences between performance of kinesthetic gross motor skills in hitting, throwing and passing were uniformly superior with visual feedback. For kicking, there was apparently no difference between feedback systems, indicating that one method (auditory or visual) was as good as the other in this skill.
CHAPTER V

SUMMARY, FINDINGS, DISCUSSION, AND CONCLUSIONS

I. SUMMARY

The purpose of this study was to analyze generality and specificity of motor performance in hitting, passing, throwing and kicking skills, performed kinesthetically and with vision. More specifically, the purposes were: (1) to analyze the generality or specificity of gross motor performance in hitting, passing, throwing and kicking skills. (2) To analyze the generality or specificity of kinesthetic gross motor performance in these skills, utilizing verbal feedback. (3) To analyze the generality or specificity of kinesthetic gross motor performance in these skills utilizing visual feedback. (4) To compare the effects of verbal and visual feedback in the four kinesthetic gross motor performance skills.

Subjects for the study were 100 male Louisiana State University undergraduate students. About one half of the subjects were Health, Physical and Recreation Education students enrolled in the majors' program. The other subjects were enrolled in regularly scheduled activity classes of gymnastics, badminton, wrestling, conditioning exercises, tennis, weight training and golf. The subjects' ages ranged from eighteen to twenty-nine.
A review of the literature revealed an overwhelming amount of evidence for specificity of task performance. However, no investigations were reported that attempted to study the question of generality versus specificity of gross motor performance when performed kinesthetically. Furthermore, no studies were found that had utilized the gross motor skills involving throwing, hitting, kicking and passing of a ball, which types of skills characterize a number of sports.

A pilot study was conducted during December, 1967, in order to establish the testing procedures, reliability and other details pertaining to the administration of the tests. The final study was conducted during the second semester of 1968.

One hundred subjects were tested in hitting, throwing, passing and kicking skills. All tests involved projection of a ball to a target of six concentric circles ranging in value from six to zero. The target center was eighteen inches in diameter and the total target was fifteen feet in diameter. Kicking and hitting were performed from a distance of thirty-eight feet, and throwing and passing were performed from a distance of forty-two feet. A soccer ball was used for kicking and passing, a softball for throwing, and a tennis ball and paddle racquet for hitting.

Subjects were tested on each event in three ways. Ten trials were given to each subject while blindfolded. After
each trial the subject was informed verbally as to where the ball hit. This constituted kinesthetic performance with auditory feedback. Ten trials were given; after each, the subject was allowed to remove the blindfold to see where the projectile landed. This constituted kinesthetic performance with visual feedback. Ten trials were given allowing the subject full use of his vision. Counterbalancing of test events and feedback systems was utilized as a learning control measure.

Zero order correlation was employed to determine relationships between kinesthesis and generality and specificity of the various types of motor performance. Factorial design was utilized to compare the effects of the different motor skills, kinesthetic performance with auditory feedback and with kinesthetic performance and visual feedback, and the interaction between type of feedback and type of motor skill.

II. FINDINGS

1. Overall, highest correlations (indicating more generality) among the performances in the four gross motor skills were obtained when subjects performed with full vision. The coefficients of correlations ranged from .26 to .45.

2. The lowest correlations (indicating less generality) among the four gross motor skills were found when the subjects
performed blindfolded with only auditory feedback. The coefficients of correlation ranged from .03 to .43.

3. The relationships between performances with vision and blindfolded performances with visual feedback were considerably higher than the relationships between performances with vision and performances with auditory feedback.

4. Significant correlations were also found between kinesthetic performance with visual feedback and kinesthetic performance with auditory feedback in all four gross motor skills.

5. In analyzing specificity and generality within the four gross motor skills, kicking performance was found to show the most specificity, especially when performed kinesthetically with auditory feedback. Similarly, when viewed under all of the conditions of performance, passing showed the most generality; although the correlations were too low for prediction.

6. The highest relationships between any two motor skills under each of the three conditions of performing were found between passing and throwing.

7. From analysis of variance, it was found that kinesthetic performance with visual feedback was superior to kinesthetic performance with auditory feedback in overall performance in the four motor skills.
8. A significant interaction was found which indicated that the differences between visual feedback and auditory feedback were not uniform in each of the four gross motor skills. Through orthogonal comparisons it was found that the difference between visual and auditory feedback was clearly not as pronounced in kinesthetic kicking performance as it was in the other three skills.

III. DISCUSSION OF FINDINGS

More generality was found for gross motor performances with full vision than was found for kinesthetic performance without vision. Cratty\(^1\) had suggested that the reverse might be the case. This may have been caused by transfer of skill in corresponding sports requiring visual concentration on a target. If so, the lack of vision would seem to cause more fluctuation in performance among the different skill tests utilized.

The lower correlations between kinesthetic skills utilizing only auditory feedback were not surprising in view of the evidence of previous studies in favor of visual feedback. Robb\(^2\) found visual feedback the most important learning variable. Actually, from the literature, concurrent and immediate

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\(^1\)Bryant J. Cratty, *Quest*, *op. cit.*., p. 111.

\(^2\)Margaret Robb, *op. cit.*., p. 39.
feedback of three types (visual, verbal and kinesthetic) seems better than any one type. Thus, it could also be expected that the kinesthetic performance with visual feedback would relate more highly to performance with full vision than kinesthetic performance with auditory feedback.

Kicking skill was more specific to the task than any of the other three skills. This may be attributable to the background of the subjects' previous sports experience. Soccer is not a sport that is introduced to great numbers of youngsters in this country. Football kicking is ordinarily performed by only one or two members of the team who often come to be specialists. Thus, ability in kicking related least to skill in the other three tasks. Conversely, passing skill produced the most generality. This too could probably be attributed to the emphasis on passing in American sports. Since passing and throwing are both integral to nearly every American sport, they could be expected to relate more highly than any of the other skills. Hitting and kicking are basically dissimilar skills and did not prove to correlate with any other skill as much as did passing and throwing. The dissimilarity of kicking skill to each of the other skills was also pinpointed by the significant interaction which indicated the differences between visual feedback and auditory feedback.
were not uniform in each of the four gross motor skills. This probably was due to the overall poor performance in kicking, and consequently, the type of feedback was incidental.

IV. CONCLUSIONS

1. The tests for hitting, throwing and passing revealed more generality than was found for kicking. Apparently activities requiring use of the leg and foot are more specific to the task than activities requiring use of the hand and arm.

2. Auditory feedback does not seem to significantly affect performance in kinesthetic gross motor skills.

3. Although visual feedback for gross motor performance was not nearly as effective as full vision, it is of some value to kinesthetic gross motor performance.

4. Overall visual feedback is significantly superior to auditory feedback in kinesthetic gross motor performance.
SELECTED BIBLIOGRAPHY

A. BOOKS


B. PERIODICALS


Lawther, John D. "Directing Motor Skill Learning," Quest, Mono. 6 (May, 1966), pp. 57-76.


C. THESES


APPENDIX A

DUPLICATE OF SCORECARD UTILIZED TO RECORD RAW DATA FOR ALL TESTS

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APPENDIX B

INSTRUCTIONS THAT WERE READ TO THE SUBJECTS

The first thing you will do is fill out the information at the top of your score card. Print your last name first, your first name, your age, and the date. While you still have the score card look at it for a moment as we discuss the tests.

You will perform four tests. They are hitting, throwing, passing, and kicking, although not necessarily in that order. Underneath the name of each test you will see three items labeled verbal, visual, and eyes open. Underneath each of these titles you will see ten blank lines. You will be given ten trials in each of the three methods, or a total of thirty trials for each test. The column entitled "verbal" refers to the fact that you will receive verbal information and instruction while you perform ten trials completely blindfolded. The column entitled "visual" means that after each trial you may raise the blindfold to see where the ball landed on each trial. Eyes open means that you will perform ten trials with no blindfold.

The blindfold is actually a pair of opaque goggles taped to insure an absence of vision. Here are the two sets of goggles. You may put them on and adjust the head band.
Now remove the goggles and I will demonstrate each of the four tests. Listen and watch carefully for you will not be allowed to practice. Every single trial will be counted.

The hitting test and the kicking test are performed from the line closer to the target. The throwing and passing tests are performed from the line farthest from the target.

The hitting test is performed by grasping the paddle ball racquet with any grip you desire and hitting the tennis ball underhand or sidearm toward the center of the six circles in the following manner (demonstration). Notice that the ball traveled over the beam in the middle of the room. Your effort will count even if the ball does not travel over the beam, but we have found that trajectory more efficient. You will perform this test in each of the three methods already described. During the tests with the blindfold, your coach will stand by you and inform you of your results or stand at the target and show you your results, depending on whether you are performing the ten trials with verbal information or the ten trials with visual information. Your coach will also mark the value of each effort on your score card. Each hit will range in value from zero for a complete miss to six for a bull's eye. Each of the other three tests are performed in a like manner.
The kicking test is performed from the same line as the hitting test. The kick is executed in a manner similar to the punt in football by dropping the soccer ball with two hands and kicking it toward the center of the target. You may kick it off the instep or the side of the foot soccer style in the following manner. Again, you should try to make the ball go over the beam as you do for all of the other tests. However, the effort will count even if you are unsuccessful in causing the ball to travel in that trajectory.

The softball throw is performed from the back line. An overhand one hand throw is required. Any stance is legal. Any style of throw other than a hard line drive is recorded. The following style is recommended.

The chest pass with the soccer ball is performed from the same line as the softball throw. It is done by executing what looks like a two-hand basketball push pass. Two hands are required but you may use a parallel or staggered stance. Again, it is suggested that you try to make the ball travel over the beam in the following manner.

On any of the tests if the ball should strike the beam or ceiling and is traveling in the direction of any part of the target, you will be allowed a retrial. This judgment will be made by your instructor. If the ball is traveling in an obviously errant direction you will receive
a zero for that trial. All miss hits will be recorded as zero. Other hits will be given the value of the circle in which the ball lands. If the ball lands on a line, the value of the highest adjacent circle will be recorded.

You will not be timed. However, each effort should be made as soon as you receive the ball. It will take approximately thirty minutes to test two of you at the two stations.

The coaches are ready, so put your goggles on. Coaches, you may hand the performers the ball for the first test. Performers, you should make your first effort to hit the target now.
APPENDIX C

RAW DATA FOR SUBJECT’S SCORES ON KINESTHETIC PERFORMANCE WITH AUDITORY FEEDBACK, KINESTHETIC PERFORMANCE WITH VISUAL FEEDBACK AND PERFORMANCE WITH FULL VISION ON TESTS OF HITTING, THROWING, PASSING AND KICKING SKILL

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AK = Kinesthetic performance with auditory feedback; VK = Kinesthetic performance with visual feedback; M = Gross motor performance with full vision
APPENDIX C (continued)

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AK = Kinesthetic performance with auditory feedback
VK = Kinesthetic performance with visual feedback
M = Gross motor performance with full vision
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AK = Kinesthetic performance with auditory feedback
VK = Kinesthetic performance with visual feedback
M = Gross motor performance with full vision
### APPENDIX C (continued)

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VITA

The author was born in Ray City, Georgia, on February 19, 1928. He received his elementary and high school education in Clyattville, Georgia.

The Bachelor of Science degree, with a major in Physical Education, was awarded in 1949 by North Georgia College in Dahlonega, Georgia. The Master of Arts degree, with a major in Educational Administration, was awarded in 1955 by Peabody College in Nashville, Tennessee.

The author taught at Summerville High School and Rockmart High School before serving two years in the Infantry from 1951 to 1953. After military service, the author taught three years at Southwest DeKalb High School in Atlanta from 1953 to 1956. From 1956 until 1966 the author was employed by Oglethorpe College in Atlanta. The school years 1966-1967 and 1967-1968 were spent in graduate study toward the Doctor of Education degree, majoring in Physical Education, at Louisiana State University.
Candidate: Garland F. Pinholster

Major Field: Physical Education

Title of Thesis: Analysis of Generality and Specificity of Kinesthetic Performance in Gross Motor Skills

Approved:

[Signatures]

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

May 7, 1968