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A Study of the Difference in Short-Term Memory Between Seventh Grade Students Rated High and Low in the Ability to Acquire Sport Skills

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A STUDY OF THE DIFFERENCE IN SHORT-TERM MEMORY BETWEEN SEVENTH GRADE STUDENTS RATED HIGH AND LOW IN THE ABILITY TO ACQUIRE SPORT SKILLS

by

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Vera Jeppesen Watkins

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ABSTRACT

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This study investigated the possibility that the short-term memory factor may be one of the variables involved in the learning of motor skills.

The subjects of the study were all of the seventh grade gym students at Logan Junior High School who were rated by their teachers as being in the upper or lower one-fourth of their class in respect to their abilities in sport skills. After a short-term memory (STM) test developed by the researcher was administered to this group, their scores were compared to determine whether there was a significant difference between the upper and lower one-fourth.

An analysis of variance determined that among the boys and the girls taken separately and the group as a whole, means for the top group were higher on the STM test and that the difference was significant at the .01 level. It was also found that the mean score of the entire group of girls was significantly higher than that of the boys at the .05 level. There was no significant difference in the way the STM test discriminated between the top and bottom boys and the top and bottom girls.

Since the other variables were not controlled, this study was only able to distinguish between groups, and there were many individual exceptions. However, the test showed great variability in STM ability among normal individuals in the same age group, and suggests a relationship between this ability and the ability to acquire sport skills.

(39 pages)

INTRODUCTION

Over the past ten years or so there have been many studies involving the short-term memory factor. These studies have been conducted by both physiological and behavioral psychologists and have been concerned first with the question of whether there is such a thing as short-term as distinguished from long-term memory. While there is no final, definitive answer on either the physiological or the behavioral side, it would seem that the preponderance of evidence points to the probability that there are indeed qualitative differences between the two. There have also been many studies to determine the nature and characteristics of short-term memory and how it can best be measured.

In the field of motor learning, extensive efforts have been made to determine the abilities associated with the acquisition of many precisely defined perceptual-motor tasks. Although most of these studies have been geared to the vocational field, they are important in the field of physical education too. The investigation of any learning factor is important because once a factor limiting an individual's ability to learn is uncovered, the way is cleared to finding a way to deal with it. The development of motor skills in children and young people is considered important enough for physical education to be a required course in most schools. Therefore, it would seem that the poorest as well as the best students deserve our help.

Learning sport skills is one situation in which a person's success might plausibly be dependent upon his short-term memory capacity. Although many other factors have been associated with the development of different types of motor skills, there is admittedly a large percentage of the variance still unaccounted for (Fleishman, 1967). Many investigators have emphasized the importance of feedback in motor learning, and as Ina McD. Bilodeau (1966) pointed out the provision of feedback is often intrinsic to the task, that is, the individual knows immediately whether he has hit the ball or the target. However, it seems logical to assume that the individual's use of the feedback will depend to a considerable extent on his awareness of and ability to remember what he did to bring about the desired or undesired result, and this involves short-term memory.

The problem for this research study is that so far no one has conducted any studies to determine whether there is, in fact, any observable relationship between an individual's short-term memory capacity and his ability to learn sport skills. It would be especially pertinent to investigate this possibility in young adolescents and preadolescents, who are at a sports minded age and are being trained in the skills of adult games. Sports requiring primarily skill and co-ordination rather than strength and endurance would, of course, be those most likely to be associated with the memory factor. If a relationship between short-term memory and the learning of sport skills were established, methods of facilitating the memory process during practice might be developed out of the wealth of information we already have.

REVIEW OF THE LITERATURE

The first part of the review of literature contains a discussion of the concept of memory and the differentiation between short-term memory (STM) and long-term memory (LTM). The second part goes into the question of how STM has been measured by various researchers and the third part into the factors involved in the acquisition of motor skills and how memory and intelligence may be involved.

Concept of Memory

Memory has been distinguished from learning by defining learning as trace formation, trace storage, and trace utilization, whereas memory consists of only the first two steps: trace formation and trace storage (Melton, 1963).

How little is known of the physiological and anatomic basis of either short-term or permanent memory traces is shown by the discussion of some of the most prominent experts in the field in the book, The Anatomy of Memory, edited by Kimble (1965). Some of the earlier theories of STM, such as the reverberation theory, are strongly questioned.

A large number of human behavioral studies have claimed to support the theory that STM and LTM are points on a continuum rather than a dichotomy.

A study supporting the continuity theory is that of Ryan (1968), which indicates that subjects who perform well on a related span task get similar items into LTM faster than subjects with smaller STM capacities. Other investigators have found that variables which affect performance on multiple-trial LTM, affect it similarly on single-trial STM. Jahnke and Davidson (1967) found that the effects of stimulus duration, stimulus-response duration, and anticipation interval on STM tasks were positively related to the effect of these variables on rote verbal learning as previously shown by other investigators.

It should be noted that these researchers assume that immediate recall after one presentation is to be regarded as a test of STM, while recall after subsequent presentations of the same material is to be regarded as a test of LTM, no matter how short the time intervals involved. Drachman and Zaks (1967) comment that the use of a single-trial presentation to distinguish STM from LTM seems an artificial and arbitrary device.

Some recent studies done on animals seem quite definitely to establish differences between STM and LTM in these subjects. Flexner, Flexner and Steller's (1963, p. 57) article indicates a difference in the storage locations of STM and LTM in mice:

> The antibiotic, puromycin, caused loss of memory of avoidance discrimination learning in mice when injected intracerebrally. Bilateral injections of puromycin involving the hippocampi and adjacent temporal cortices caused loss of short-term memory; consistent loss of longer-term memory required injections involving, in addition, most of the remaining cortices. Spread of the effective memory trace from the temporal-hippocampal areas to wide areas

> of the cortices appears to require 3-6 days, depending on the individual animal. Recent reversal learning was lost while longer-term initial learning was retained after bilateral injections into the hippocampal-temporal areas.

Bovet, Bovet-Nitti and Oliverio (1969) worked with two inbred strains of mice, selected for differences in learning ability. After a single "training" trial on a task involving inhibitory avoidance, retention trials were given at intervals ranging from two minutes to 24 hours after the initial trial. There was an increment in avoidance behavior in strain C3H/He when the retention trial was given from 10 to 30 minutes after training, but after that time there was a decrement in avoidance behavior. In strain DBA/2J, however, there was poor retention after 10 to 30 minutes but this was followed by an improvement during the tests involving longer time intervals. To the authors, these results support the hypothesis of a dual mechanism in memory. The C3H/He strain should be characterized by a good STM along with autonomous decay or by a rather ineffective consolidation mechanism. The DBA/2J strain, on the other hand, should be characterized by a poor STM and either little autonomous decay or an effective consolidation mechanism.

Gross, Black and Chorover (1968) did a study on the effect of hippocampal lesions on memory in rats and found that while the experimental group acquired less information on the first trial than did the control group, they did not lose it at any greater rate during the intertrial interval. However, they interpreted the result to mean that the experimental rats were deficient in learning but normal in forgetting, rather than postulating any difference in memory storage. Moldawsky and Corcoran (n. d.) subscribe to the same theory as an explanation for the results in their study, where they found that their subjects' digit span scores were depressed by situational anxiety but their vocabulary scores were not. They hypothesized that digit span scores are more sensitive to anxiety because they are a learning task whereas vocabulary taps already learned responses. This theory seems to define learning in a narrow sense, making it synonymous with memory.

Measurement of Memory

On the basis of a factor analysis of the Wechsler Adult Intelligence Scale, Cohen (1957) concluded that the test could be analyzed into three main factors which he called verbal comprehension, spatial organization, and memory (a renaming of what was previously called "freedom from distractibility"). The two subtests with the highest loading on the memory factor were Arithmetic (.32) and Digit Span (.29). Cohen, therefore, decided that the memory factor could be measured by averaging weighted scores for Arithmetic and Digit Span.

An item analysis of the Wechsler-Bellevue subtests was done by Jastak (1950). His subjects included 400 psychiatric patients, 320 boys and girls aged 11 to 16, and 880 hospital employees. His findings were that on the Digit Span subtest there was a significant difference in favor of the females on both forward and backward digits. The males did slightly better on the Arithmetic subtest, but the difference was in inverse relationship to the difficulty of the items.

There has been a trend toward reducing the number of memory items in the intelligence tests because of their relatively low correlation with the test as a whole and because of their lower reliability, due at least partly to their frequently proven susceptibility to anxiety in normal as well as abnormal subjects. Patterson (1953) recommends that the Digit Span test in the Wechsler Scales be omitted from any short form and even from the full scale in the case of individuals with average or above average intelligence. In the Stanford-Binet Manual the following statement is made regarding the 1960 revision of the test: "Reducing the number of memory tests at the adult level was done in order to make these levels factorially consistent with the rest of the scale" (Patterson, 1953, p. 35).

In measuring memory capacities, researchers have often invented tests of their own. Usually their tests have involved digit spans, as in the Wechsler Scales, or nonsense syllables or a combination of the two. Oddly enough, in view of their memory loading on the Wechsler Scales, arithmetic tests seem hardly to have been used at all for this purpose.

Blackburn and Benton (1957) have attempted to increase the reliability of the Digit Span test in the Wechsler Scales. They were able to increase the reliability of the forward, although not the reversed, digits by terminating the repetition of digits after three rather than two successive failures and by giving credit for each correct set rather than using the "highest score" method. Their method increased test-retest reliability on the Wechsler Adult Intelligence Scale (WAIS) Digit Span test with normal subjects from .70 to .80 or .81.

More recent investigators have experimented with using an accelerated rate of presentation and inserting other material between stimulus and response in order to make it difficult or impossible for the subjects to use memory techniques such as rehearsal or "chunking." However, Whimbey and Leiblum (1967, p. 313) came to the conclusion that "interspersing activity between presentation and recall affects only the difficulty of the task but does not change the psychological processes involved." They found that while interspersing activity lowered scores in general, it did not affect the relative standing of the individuals in their study. Whimbey and Leiblum also demonstrated in their study that it is possible to devise a reliable group test of memory span. Intercorrelations between the tasks in their study ranged from .87 to .91. They insured uniformity in presentation of material by the use of a tape recorder.

In addition to these verbal short-term memory (STM) tests (digits are generally considered "verbal" material for this purpose), spatial, tactile and motoric tasks have also been administered by some researchers. Hill and Bliss (1968) measured STM for tactile sensations by presenting 2 to 12 simultaneous air-jet stimuli on the 24 phalanges of both hands of their subjects. Montague and Hillix (1968) measured STM by a linear motor response involving memory for the distance a slide had been moved. Tests of this type have probably been used so seldom because of the special equipment needed and the difficulty of administration.

These tests are important, however, in that they have raised the question of whether different mechanisms mediate motor and verbal STM. Montague and Hillix (1968), in their study using 84 Navy recruits as subjects, obtained evidence for some differences, but urged caution in interpreting them as indicating underlying differences in mechanisms. They suggested that one reason for the differences might be the lack of verbal rehearsal in motor memory tests, and they cited evidence from Posner and Konick (1966) that verbal mediation was used hardly at all for recall in motor STM. In devising a memory test to correlate with the learning of sport skills, it would therefore seem advisable to cut the possibility for verbal rehearsal to a minimum. They also pointed out the differences in scoring: that whereas verbal responses were usually scored on an "all or none" basis, motor responses, such as on their test, were finely measured in small deviations from a "correct" response.

Analysis of Motor Skills

There have been large numbers of studies investigating the acquisition of motor skills. Interest in job and training placement has given impetus to the movement to separate motor skills into their basic components and to evaluate and measure individual differences in the abilities and aptitudes concerned. Fleishman (1967) referred to investigations of more than 200 tasks administered to thousands of subjects in a series of interlocking studies. They include such abilities as control precision, multilimb co-ordination, response orientation, reaction time, etc. On the basis of these studies, Fleishman (1967, p. 178) stated as follows:

> It does appear that in the perceptual-motor domain a relatively few abilities are very useful in organizing quite meaningfully a wide variety of performances. This does not mean that there are no more factors to discover. And it does not mean the factors identified account for a large proportion of the variance in every psychomotor task - far from it as will be seen later.

Another conclusion from the studies was that the particular combination of abilities contributing to performance changes as practice continues. Moreover, the contribution of "non-motor" abilities (e. g., verbal, spatial), which may play a role early in learning, decreases systematically with practice, relative to motor abilities. The memory factor was not mentioned as having been investigated in relation to motor learning.

Memory in respect to motor skills has been investigated as it relates to the retention of skills already learned. This kind of study has led to the conclusion that retention falls very fast in verbal learning, but hardly at all in motor learning (E. A. Bilodeau, 1966). However, as Hunter (1934, p. 540) has pointed out, "it would be possible for any teacher of swimming or dancing to cite numerous cases when certain responses have appeared correctly once . . . and yet are forgotten, i.e., cannot be reinstated, five minutes later." If it is hypothesized that immediate recall is important in motor learning, it is easy to see why the task would be difficult compared to most verbal memory tasks. Motor learning usually involves awareness and memory of a large number of stimuli presented together with only one brief exposure at a time. Moreover, it has been shown that memory "techniques" are only slightly effective, if at all, in getting this type of material into STM.

It seems likely that memory and the mechanism frequently referred to as "feedback" are intimately connected in the process of motor learning. Many studies have indicated that performance is lowered if feedback is reduced, eliminated or impoverished. In learning sport skills, feedback is often intrinsic to the task, i. e., the very nature of the task provides its own feedback. However, as Ina McD. Bilodeau, (1966, p. 256) has pointed out, "The subject's cognizance of what he is doing or has done is not IF [information feedback], nor is the proprioceptive stimulation produced by the behavior . . ." What Bilodeau refers to as the directive property of information feedback must be included to make the process complete.

L. E. Kulcinski (1945) conducted a study to determine the relationship of intelligence and the learning of fundamental muscular skills in fifth and sixth grade children. His 105 subjects ranged in IQ from 41 to 125. All were given a pre-test, 10 practice sessions, and a post-test. The degree of learning as indicated by the difference between pre- and post-tests was compared for superior, normal and subnormal I. Q. groups using the Chi Square method. It was found that both the normal and superior groups learned more than the subnormal group on both the simple and the difficult battery of tests, the normal group learned more than the superior group on the simple battery, and the superior group learned more than the normal group on the difficult battery. In general the girls were found to be superior to the boys in learning the motor tasks used in this study. Kulcinski's study indicates that general intelligence is not an important factor in motor learning in normal fifth and sixth grade children.

It has been pointed out that many factors, including that of general intelligence, have been investigated in relation to the learning of motor skills. Memory, too, has been considered, but only in relation to the retention of skills already learned, not in relation to the learning process itself. Although, admittedly, the very existence of an STM factor has been questioned, there appears to be considerable evidence that a factor of this type not only exists, but may represent a different level of mental activity than LTM.

OBJECTIVES

The general concern of this study is to determine whether there is any relationship between the short-term memory capacity of young adolescents and preadolescents and their ability to acquire sport skills requiring co-ordination and precision in movement. From the review of the literature, it is seen that feedback is necessary during the process of learning motor skills and that feedback is provided by the very nature of most sport skills. It is also apparent that awareness and memory of what one has done can logically be assumed to be necessary to facilitate the directive nature of feedback.

Although many variables have been associated with m otor learning, many others are still unaccounted for. In spite of the fact that it has been demonstrated that it is possible to make an adequately reliable group test of memory span, there has so far been no effort to investigate this factor in relation to the learning of motor skills.

It is hypothesized, therefore, that a positive relationship will be found between the ability to acquire sport skills requiring co-ordination and precision in movement and short-term memory capacity as measured by a predominantly verbal memory span test, and that this relationship will be statistically significant at least at the five percent level.

The following questions will also be asked:

1. Is there a significant sex difference in performance on the STM test?

2. Is there a significant sex difference in the relation between the memory factor and the acquisition of sport skills?

PROCEDURE

Population and Sample

The sample consists of all of the children in seventh grade physical education classes in Logan Junior High School, with the exception of those in the special education class. The latter were excluded because they have been classified as mentally retarded, and the evidence indicates that the correlation between general intelligence and motor learning is significantly higher when the mentally retarded are included (Kulcinski, 1945). Seventh graders were singled out for the sample because in the Logan District the student's first experience with a regular physical education program under the direction of a specially trained teacher occurs in that grade. Presumably, then, they should be acquiring new skills and perfecting old ones at a rapid rate.

There are nine gym classes in all, with one teacher for the boys and two for the girls. All seventh grade students are required to take physical education all year unless excused by reason of physical disability. Although no random sample is possible in this case, since the classes are already set up, it is felt that including all the classes (with all physically and mentally normal children enrolled) should eliminate biases due to differences in teachers or class composition. As there are generally 30 to 40 children to a class, the total number should be adequate for dividing into subgroups needed.

To be cautious, one should extend the results of this study only to seventh graders of Caucasian and middle or lower middle class background, since this is the predominant makeup of the Logan child used.

Design

The physical education teachers were asked to select what they considered the top one-fourth and the bottom one-fourth of the students in each of their seventh grade classes in respect to their adeptness in learning sport skills. This selection was made after over one-half of the school year was over so that the teachers would have ample opportunities to become acquainted with their abilities in a number of areas. The teachers were informed personally and in writing that the experimenter was interested in skill and co-ordination rather than in such factors as strength or a cooperative attitude. The subjects were not informed of the reason for their selection. The middle students in ability were not included in the experiment since it was assumed that they would all be close enough to the average to make it difficult to discriminate between them.

The short-term memory test developed by the experimenter was administered to the selected members of each class. One class at a time was taken to a vacant classroom where the test was given, since for this type of test it was considered necessary to have maximum conditions of audibility, visibility and freedom from distraction. Attention was also paid to the question of whether each child was equipped with a sharp pencil and was able to see adequately where he was placed.

It was considered desirable to keep anxiety at a minimum and yet to provide some kind of motivation. The children were told that the test was neither a gym test nor an intelligence test and that no one at the school would be told their scores except that the names of those receiving the highest scores in each class would be announced. They were also told that those receiving the lowest scores would be helping the researcher just as much as those receiving the highest scores as long as they did their best. It was recognized that the test would be harder for some than for others.

In order to eliminate experimenter bias, the researcher was not told which children were in the top or which in the bottom quarter of the class until after the papers were corrected and the names of the high scorers turned in.

Data and Instrumentation

Since there was no group test of short-term memory available for this age group, it was necessary to develop a new one especially for this study. In developing the test, various ideas were borrowed from other research. The basic idea of the digit span section was borrowed from the Wechsler Scales, but it was adapted for group administration, and the scoring was changed in line with one aspect of Blackburn and Benton's (1957) reliability study, i.e., giving credit for each span reproduced correctly rather than counting only the longest reproduced span. Another change was made by adding spans given at a higher rate of speed and interspersing activity between presentation and recall (Whimbey and Lieblum, 1967). The spatial memory items were adapted from the Stanford-Binet test.

Arithmetic items are not usually considered as constituents of a short-term memory test. My justification for including them in this test is found in Cohen's factor analysis (1957) which indicated that the Arithmetic subtest in the WAIS is as good a memory test as the Digit Span subtest. My arithmetic items should be more free of other intelligence factors than the Wechsler subtests because the reasoning aspect has been eliminated, and the computation involves only simple number facts taught in the lower grades of elementary school.

My preliminary adaptations of this test were made with the help of my own children, aged 12 and 16. I then tried a 15-item preliminary test on a group of Edith Bowen School sixth grade students. The group consisted of five boys and five girls of varying I.Q.s ranging from 91 to 129. A rank order correlation of the test with the I.Q.s yielded a coefficient of .39. The subjects' performance seemed quite consistent on the different kinds of items on a test. As a result of this trial, a few items were eliminated because of being too easy or too difficult, and the rate of presentation of the arithmetic and spatial items was changed. The children were cooperative and the test seemed to hold their interest.

It was felt that with the variety of items presented, it would be possible to increase the length of the test to 20 items and still avoid deterioration of performance due to boredom or fatigue.

In the Spring of 1968, a pilot study was conducted with the top and bottom one-fourth of a boy's gym class and a girl's gym class at the Logan Junior High School. There were 18 boys and 15 girls in the groups. Although the means of the top one-fourth were higher than those of the bottom one-fourth, the numbers were not large enough to produce statistically significant differences. The mean score for the boys was considerably lower than for the girls, and the difference in scores was particularly apparent at the lower limits. It was suspected that some of the boys simply "gave up" when they saw they were not doing well; therefore more attention was placed on how motivation might be increased in introducing the test to the children (see Design, p. 17).

The test itself was changed very slightly as a result of the pilot study. It was found that # 12 (the first arithmetic problem) was very difficult due to the change in set, being passed by only two girls and no boys. It was therefore simplified by eliminating one operation. Two of the designs were changed and presented singly instead of both at one time, and the order was changed in the hope of making them of more equal difficulty. See memory span test in Appendix.

Analysis

To ascertain the reliability of the STM test used in the study, an odd-even split-half correlation was run on the computor and the self correlation of the whole test was then estimated by the Spearman-Brown prophecy formula.

An analysis of variance was run to determine the significance of the difference between means in the scores of boys versus girls, top quarter versus bottom quarter in all of the gym classes, top quarter versus bottom quarter among the girls and top quarter versus bottom quarter among the boys.

RESULTS

The hypothesis was that a positive relationship would be found between the ability to acquire sport skills requiring co-ordination and precision in movement and short-term memory capacity as measured by a predominantly verbal memory span test, and that the results would be significant at least at the five percent level.

The mean of the top one-fourth group in terms of sport skills was 11.925 on the STM test compared with a mean of 9.312 for the bottom one-fourth group.

Table 1. Analysis of variance: hypothesis

Source	DF	SS	MS	F
Total	160	2575.641		
Treatments	1	274.892	274.894	18.997
Error	159	2300.746	14.470	

Referring to the table of F-ratios we can see that the results are significant at the one percent level. We can, therefore, safely reject the null hypothesis in respect to the hypothesis tested in this study.

The first question was whether there would be a significant sex difference in performance on the STM test.

The mean of the total number of boys on the STM test was 9.865 and that of the total number of girls was 11.170.

Table 2. Analysis of variance: boys vs girls

Source	DF	SS	MS	F
Total	160	2575.641		
Treatments	1	66.570	66.570	4.218
Error	159	2509.070	15.780	

According to the table of F-ratios, the results are significant at the five percent level. The answer to the first question is, therefore, that there is a significant sex difference in performance on the STM test in favor of the girls.

Many studies and observations have indicated that girls and women tend to be more conscientious and better able to concentrate on details than boys and men, while males tend to be better at problem solving activities. This may be at least a partial explanation of why girls excell at short-term memory tasks, which require a high degree of freedom from distractibility.

The second question was whether there was a significant sex difference in the relation between the memory factor and the acquisition of sport skills.

A two-way analysis of sex by position yielded the following results:

	Top 1/4	Bottom 1/4
Boys	11.088	8.606
Girls	12.531	9.808

Examination shows us that the answer to the second question is "no" since the difference between the mean of the top and bottom girls is 2.723 compared with a difference of 2.282 in the boys.

The reliability of the test was ascertained by the odd-even split half method. The correlation between the halves was .63 and application of the Spearman-Brown formula to correct for length yielded a reliability coefficient of .77.

The .77 reliability coefficient of the STM test does not seem impressive when compared with that of many kinds of standardized tests. However, STM tests in general are reported to have relatively low reliabilities. Blackburn and Benton (1957) have told how they were able to increase the reliability of the WAIS Digit Span test from .70 to .80 or .81.

DISCUSSION

This study has been restricted to a sample of seventh grade children, and it would be interesting to repeat it with other age groups to see if the results would still hold true. A more valuable study, although difficult, would be one in which as many other variables as possible would be held constant. Another possibility would be to use a motor memory test instead of a verbal one, since there may be differences between motor and verbal STM (see p. 9). The difficulty here would be the necessity of either evolving a satisfactory group motor STM test or finding the time and opportunity to give individual tests to an adequate number of subjects.

The "purity" of the experimenter's test from the standpoint of factor analysis might have been improved by including only the type of item found most highly correlated with STM. However, as mentioned before, variety was felt to be desirable in holding the interest of the subjects. It was also felt that a "broad band" test has certain intrinsic advantages in that extraneous factors inherent in the kind of item used might have their effects cancelled out.

The finding that girls were superior to boys on the STM test was in accord with the findings of Jastak (1950) in his study of sex differences on the Wechsler Digit Span subtest. It is interesting to note that in Kulcinski's study (1945) when fifth and sixth grade children were given the same motor tasks to learn, the girls proved superior to the boys.

Although it is recognized that many factors are involved in learning motor skills, this study points to the conclusion that the short-term memory factor is among them. It is hypothesized that in the learning of sport skills, the STM factor works to make feedback effective as a correcting influence. This kind of memory process should not be confused with the remembering of skills already learned, a process dealt with in a number of other studies.

SUMMARY AND CONCLUSION

This study investigated the possibility that the short-term memory factor may be one of the variables involved in the learning of motor skills.

The subjects of the study were all of the seventh grade gym students at Logan Junior High School who were rated by their teachers as being in the upper or lower one-fourth of their class in respect to their abilities in sport skills. After a short-term memory test developed by the researcher was administered to this group, their scores were compared to determine whether there was a significant difference between the upper and lower one-fourth.

An analysis of variance determined that among both the boys and the girls taken separately and the group as a whole, means for the top group were higher on the STM test and that the difference was significant at the .01 level. It was also found that the mean score of the entire group of girls was significantly higher than that of the boys at the .05 level. There was no significant difference in the way the STM test discriminated between the top and bottom boys and the top and bottom girls.

Since the other variables were not controlled, this study was only able to distinguish between groups, and there were many individual exceptions. However, the test showed great variability in STM ability among normal individuals in the same age group, and suggests a relationship between this ability and the ability to acquire sport skills.

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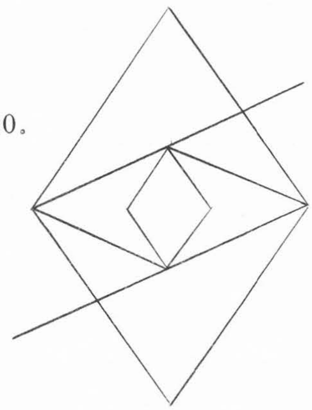
APPENDIX

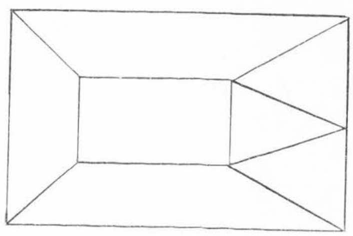
Memory Span Test

1. 5-1-7-4-2-3
2. * 9-8-5-2-1-6
3. H-9-4-8-7-5-6
4. 1-6-4-5-9-7-6
5. * 2-9-7-6-3-1-5
6. A-7-3-9-1-4-7-8
7. 4-1-3-5-7
8. * 9-7-8-5-2
9. N-5-9-3-1-8
10. 1-6-5-2-9-8
11. * 3-6-7-1-9-4
12. 6 + 1 - 5 x 4
13. 8 - 2 x 4 ÷ 3 + 1
14. 2 + 5 - 1 ÷ 3 x 8 - 4
15. 6 - 2 x 5 ÷ 4 + 1 - 3
16. 1 + 7 ÷ 2 - 1 + 3 x 2 ÷ 3
17. 5 - 1 x 2 - 4 x 4 ÷ 8 + 3

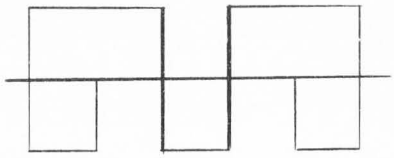
20.



18.



19.



Method of administration

Subjects are instructed to repeat digit spans 1 through 6 forward and 7 through 11 backward on their papers. Spans 1, 4, 7, and 10 are given orally at the rate of one per second, the starred spans at 2 per second, and the ones preceded by letters at 2 per second. The letters are printed on 5 1/2 by 10 cards and are shown to the subjects after the oral presentation of the digits. The subjects have been instructed to write the letter down first, then the digits.

Arithmetic problems 12 through 17 are given at the rate of one digit per second and three arithmetic signs per second.

Numbers 18, 19 and 20 are reproduced on 10 by 12 cards which are shown one at a time to the subjects while the administrator counts to three at the rate of one count per second. The card is then concealed and the subjects are asked to copy the figure as accurately as possible from memory. The figures are judged on the basis of whether the general idea is reproduced rather than on neatness or artistic merit. For example, a rectangle must have the general shape of a rectangle and lines which are supposed to intersect must do so.

In scoring, equal credit is given for each of the 20 items, and each item is scored either right or wrong. The total score is the total number of correct items.

VITA

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Master of Science

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