REMINISCENCE IN TWO DISCRETE MOTOR LEARNING TASKS

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CHAPTER I

INTRODUCTION

In the field of physical education many studies have been conducted in an effort to define favourable conditions of practice with respect to the performance and learning of motor tasks. Although most researchers agree that distributed practice leads to better performance than does massed practice (18, 36, 48), the influence of practice conditions on learning is not so well documented. After summarizing much of the pertinent research on this subject, Mohr concludes:

> "Although the sum of the physical education findings agree with those in psychology, the evidence is far too scanty to uphold the assumption that distributed practice will result in more effective learning than massed practice." (36, p. 349)

Since there are usually many skills to be learned in a limited period of time in most physical education programs, and since the same amount of actual practice is done in much less time under massed conditions, it is important to gather new information about the phenomenon of reminiscence, one of the principle characteristics of this method of practice.

In psychology, explanation of the phenomenon of reminiscence has been an important subject of research in the field of retention and forgetting. Different theories have attempted to explain the mechanisms underlying reminiscence. Hull's (22) theory, based on constructs called reactive and conditioned inhibition, has encouraged much investigation in this area of research. It has also been shown that "consolidation of memory traces" could represent a logical explanation for the existence of reminiscence. More recently, Eysenck (16) has proposed a three-factor theory of reminiscence in which he combines the two-factor theory of inhibition and the consolidation hypothesis. This author suggests that reminiscence-producing mechanisms may differ from one task to another. He has thus concluded that reminiscence is task specific. (However, in physical education the term specificity refers to the inconsistency of individual differences). For the purpose of this study it is of interest to know if the person whose reminiscence score is the highest in one task will also be the highest in a second task. This connotation of specificity has more direct implication to the actual teaching of skills and tells us something about the nature of reminiscence.

Since most of the theorizing about reminiscence has been formulated from studies conducted on the pursuit rotor which is a continuous task, there is a distinct hazard in applying inferences from this research to the teaching of physical skills,many of which are discrete tasks. Hence it is important to establish whether the phenomenon of reminiscence may occur in discrete tasks provided the proper conditions of practice are secured.

Purpose of the study:

This study has four purposes:

1) To determine whether or not reminiscence will occur in two discrete tasks.

2) To determine at what stage significantly greater amounts of reminiscence appear in the practice of two discrete tasks.

3) To determine if individuals who demonstrate large amounts of reminiscence at one stage of practice are also the same individuals who demonstrate relatively large amounts of reminiscence at a later stage of practice in the same task.

4) To determine if individuals who reminisce in one discrete task maintain their relative positions of reminiscence in a second discrete task.

Need for the study:

Singer has stated that:

> "Physical educators have an obligation to examine, understand, and apply the learning concepts where feasible and apparently appropriate." (45, p. 13)

Like many other learning phenomena, reminiscence, which is known to occur under conditions of massed practice, has been studied almost exclusiyely in psychological research. Yet physical education teachers who often use massed practice would certainly benefit from knowing more about this particular phenomenon. Experimental research on reminiscence has two definite limitations. Firstly, much of what we know about reminiscence in motor learning is based on pursuit rotor data, a continuous task. The second limitation is that most of the studies conducted concerning reminiscence deal with problems associated with conditions of practice and identification of reminiscence producing mechanisms, while not much is known about the performers' ability to reminisce consistently from one task to another or through different stages of the same task.

Although a certain number of studies exist indicating the appearance of reminiscence when using a discrete task (10, 40, 44), only one of these investigated the possibility that reminiscence could occur under massed practice conditions. The scarcity of experimental evidence on this subject combined with the fact that a great number of physical education skills are in fact discrete, indicate the need for further research. Before it is possible to generalize from a theoretical model to the practical situation, it is necessary to determine whether or not reminiscence occurs in a discrete task when the conditions of practice are highly massed.

Also related to the hazard of applying inferences from one experimental area to another, is the fact that the amount of reminiscence has been shown to decrease as a function of the increase in learning when continuous tasks were used (4, 6, 9, 24). The limited number of studies using a discrete task indicate that reminiscence does not follow the same decreasing pattern as that found in continuous tasks. Hence there is a definite need to obtain more evidence as to the exact stage in practice where reminiscence occurs in a discrete task.

One of the most practical questions a teacher could raise is whether performers reminisce consistently from one task to another, or, in other words, if individuals who demonstrate relatively large amounts of reminiscence in one task are also the same individuals who demonstrate relatively large amounts of reminiscence in a second task. In physical education it is well documented that performance is specific to the nature of the task. However very limited evidence has been obtained about the specificity of individual differences in reminiscence.

Also, related to this problem is the question of reliability of individual differences in reminiscence. This characteristic refers to the inconsistency of individuals in reminiscing from one stage in a task to another stage of the same task. Again the very limited number of scientific investigations in this area suggests a need for further research.

Hypotheses:

1. No reminiscence will occur, under massed practice conditions, on either of two discrete tasks.

2. There is no significant difference between the amount of reminiscence at different stages of practice on the same task, for either of two discrete tasks.

3. There is no relationship between reminiscence scores at one stage of a discrete task and reminiscence scores at a different stage of the same task.

4. There is no relationship between reminiscence scores in one task and reminiscence scores in a second task.

Definition of terminology:

Conditioned inhibition:

Whenever the organism is allowed a rest during which reactive inhibition dissipates, this dissipation serves as a reinforcer and the response of resting becomes conditioned to stimuli presented in the learning situation. This conditioned resting response tendency is called conditioned inhibition.

Performance:

Performance is a temporary occurence, fluctuating from time to time because of many potentially operating variables. (45, p. 3)

Reactive inhibition:

Whenever any reaction is evoked in an organism, there is left a condition or state which acts as primary negative motivation in that it has an immediate capacity to produce a cessation of the activity which produced the state. We shall call this state or condition reactive inhibition. (22, p. 278)

Reliability of reminiscence scores:

The consistency of individual reminiscence scores from one stage of practice to another stage of practice on the same task.

Specificity of reminiscence scores:

The inconsistency of individual differences in reminiscence scores from one task to another task.

Reminiscence:

Reminiscence is the opposite of forgetting, for it is the phenomenon in which performance increases after a rest interval and is therefore attributable to rest. (45, p. 196)

Limitations of the study:

1. The reliability of the two tasks used in this study was rather low (.5649 and .5154 respectively).

2. The subjects were drawn entirely from the school

of physical education at the University of Ottawa and thus, the generalizations are limited to this group or groups with similar characteristics.

3. The degree of motivation throughout the testing sessions could not be rigidly controlled.

4. It was impossible to control for the subjects' physical activity prior to the testing periods.

CHAPTER II

REVIEW OF RELATED LITERATURE

The literature pertinent to the present investigation has been logically divided into the following five subdivisions for review:

1) those studies related to the inhibition theory;

2) those studies related to reminiscence and the consolidation hypothesis;

3) those studies related to the three factor theory of reminiscence;

4) those studies related to the use of discrete tasks in the study of reminiscence; and,

5) those studies related to reliability and specificity of reminiscence.

Reminiscence and the inhibition theory:

Ammons (3), in a quantitative analysis and theoretical formulation in the area of motor skill acquisition, noted striking similarities in various reported curves of motor performance: performance after rest was characterized in each case by 1) an abrupt rise to a level much higher than that to be expected if there had been no rest (reminiscence); 2) a gradual flattening off leading to a relatively decremental segment after this abrupt rise;

3) resumption of the pre-rest curve of gradual improvement or at least some sign of this; and 4) a fairly definite permanent difference in performance levels between groups practising under different conditions of distribution of practice. Ammons insists that these characteristics are not present in all learning curves. They seem to appear most clearly in the learning of motor tasks where blocks of massed trials are separated by rests of several minutes and where the task is a novel one in the fairly early stages of learning.

The first characteristic mentioned above (reminiscence) is of particular interest in our study. Ammons accounts for this phenomenon in terms of two variables: temporary work decrement and permanent work decrement (similar to Hull's reactive and conditioned inhibition).

In motor learning, the relative decrement in performance after rest, and the fact that performance scores in distributed practice are usually higher than performance scores in massed practice, have all been accounted for (3, 4, 5, 24, 26, 27, 47) by means of two inhibitory processes most commonly of the type postulated by Hull (22). The first process, reactive inhibition, is essentially a negative drive state originated and developed by repeated responding. Its main effect is to depress performance during a session of massed practice. Reactive inhibition is considered to be a response which results from or accompanies any effortfull behavior whether reinforced or not. Although it is possible that reactive inhibition may take a long time to completely dissipate (25), research has shown that, in general, reactive inhibition can dissipate almost completely within a relatively short period of time (4, 8, 24, 27, 29). In massed practice the rest periods are too short between each trial for reactive inhibition to dissipate, thus reactive inhibition accumulates and an increasing tendency for the organism to stop working develops. When the programmed rest pause arrives, the major part of reactive inhibition disappears and this dissipation serves as reward or reinforcement. Since pauses serve as reinforcers it follows that the response of resting will become conditioned to whatever stimuli are present in the learning situation. This conditioned resting response tendency is called conditioned inhibition, the second inhibitory component represented in the total inhibitory potential.

Hence the two inhibitory factors are alike in that they both obscure the actual strength of the habit, but beyond this, the hypothetical properties assigned them differ.

While the inhibition theory logically accounts for the reminiscence phenomenon, several studies testing experimental predictions based on the inhibition theory indicate a partial failure of this theory.

Based on the fact that reactive inhibition is a negative drive i.e.,it acts to partially cancel out the needs leading to the continuation of practice, Kimble (29) hypothesized that highly motivated subjects (having stronger needs leading to the continuation of practice) would continue to practise in spite of the presence of an amount of inhibition which would produce a cessation of activity in less highly motivated subjects. This reasoning led to the experimental prediction that the amount of reminiscence, which is correlated positively with the amount of reactive inhibition, will increase with an increase in motivation. In fact, Kimble's results did confirm his prediction. Studies from Wasserman (47) and Eysenck and Maxwell (15) also show results in accordance with Kimble's experimental prediction.

However, in a later paper, Eysenck (16) suggested that while at first the confirmation of this prediction might appear to strengthen the inhibition theory of reminiscence, it can be shown that the experiments in question actually discredited the theory. Eysenck's argument is based on the fact that the theory requires the pre-rest performance of the high motivated group to be superior to the low motivated group. In fact, many studies do show that there is no significant difference between high and low motivated groups in pre-rest performance:

"The extensive studies by Eysenck and Maxwell (1961) Eysenck and Willet (1961), Willet and Eysenck

> (1962) and Feldman (1964a) have shown that as far as pre-rest performance is concerned there are no differences between high-drive and low-drive groups; the substantial differences in reminiscence found were all due to post-rest differences in performance. This finding is incompatible with an inhibition hypothesis." (16, p. 168)

Again based on the inhibition hypothesis, Rachman (42) predicted that a strong alien stimulus should have the effect of dissipating part of the reactive inhibition if applied shortly before the rest period when practice was done under massed conditions. It was hypothesized that dissipation of reactive inhibition would increase performance just prior to rest and therefore reminiscence would decrease. The results indicated that reminiscence did in fact decrease. However, contrary to expectations, pre-rest performance did not increase.

According to the inhibition theory, subjects working under massed practice conditions should accumulate reactive inhibition which would cause a decrement in late pre-rest performance. Furthermore, reminiscence is accounted for by the dissipation of reactive inhibition during the rest period hence allowing performance to start at a higher level at the beginning of the post-rest practice. However, Rachman's results and those of Wasserman (47),and Eysenck and Maxwell (15) are not in agreement with this interpretation. One possible way to clarify the acceptability of the inhibition theory would be to compare the reminiscence obtained in two groups, one showing pre-rest decrement and the other showing no pre-rest decrement. The hypothesis would predict that the group showing pre-rest decrement would have accumulated reactive inhibition while the group not showing pre-rest decrement would not and that the rest period would have the effect of dissipating the reactive inhibition. Thus, reminiscence would be expected to be higher for the pre-rest performance "decrement" group than for the "non-decrement" group. Eysenck, in fact, tested this hypothesis and his conclusion once again indicates a partial failure (in terms of explaining the presence of reminiscence) of the inhibition theory:

> "Nothing of the kind was in fact found; reminiscence scores were completely independent of amount of pre-rest performance decrement." (16, p. 169)

One further aspect relating to the inhibition hypothesis is difficult to interpret in terms of inhibitory concepts alone. It has been shown that reminiscence occurs even after very long rest intervals. Studies by Melton (35), Jahnke and Duncan (25), and Koonce et al (30) found significant amounts of reminiscence after giving very long rest intervals. Melton's study indicated that reminiscence gains could be detected following a rest interval of six weeks; Jahnke and Duncan's systematic investigation revealed little decrease in the reminiscence effect after rest intervals of up to four weeks; Koonce et al conducted a study in which they had experimental groups with programmed rest intervals of 10 minutes, 1 day, 7 days, 35 days, 70 days, 175 days, 375 days and 735 days. An analysis of variance indicated no significant differences in post-rest performance between those groups. In addition, the authors noted a surprisingly high degree of performance on the reminiscence gains. Conversely, Bell (7) failed to obtain reminiscence after a period of one year, although, in this study, pre-rest training was given under conditions of relatively spaced practice, a condition unfavourable to the production of large amounts of reminiscence.

Considering studies where short rest pauses were used, it was logical to assume that reminiscence was due only to the dissipation of reactive inhibition since the subject did not have time to forget. However, the mere fact that forgetting did not take place in studies using very long rest periods suggests that reminiscence could possibly be due to two different factors; one could be the dissipation of reactive inhibition, and the other, a factor that assists in storing the acquired knowledge. Research relating to this "storing" or "consolidation" will be considered next.

The consolidation hypothesis and reminiscence:

Grossman (19), Deutsch and Deutsch (14) Leukel (34) and Thompson (46) have shown that, in recent years, clinical observations as well as experimental studies on human and animal subjects have rendered the consolidation hypothesis tenable and demonstrated its relevance to retention and reminiscence phenomena.

Hilgard and Bower (21) offer a good synthesis of the consolidation hypothesis first put forward by Muller and Pilzecker (37):

> "The neural activity responsible for storing a physical change encoding an experience persists for some time after that experience, and as a consequence of the perseverating neural activity, the physical changes became more firmly fixed or of greater magnitude. This progressive fixation with time is called consolidation. If this persisting neural activity is soon interrupted by the intrusion of interfering activity, then the physical change is of small magnitude and the retention of the experience should be poor." (21, p. 447)

The consolidation hypothesis is based on experiments indicating that drastic alterations in the state of brain activity interfere selectively with recently learned responses.

As noted by Hilgard and Bower (21) Leukel (34) and Deutsch and Deutsch (14), most of the observations on amnestic cases seem compatible with the consolidation hypothesis; the person recovering from amnesia first recovers memories of events more remote in time from the injury. As recovery continues, events closer in time to the accident can be recalled but those immediately preceding the injury are unrecoverable. From the consolidation point of view, older memories had had more time to consolidate and, when recovery was initiated, the threshold for recall (that had increased because of the injury) starts decreasing and the first memories to reach that threshold are the more consolidated ones, the old memories.

More convincing evidence with respect to the consolidation hypothesis is noted in the experimental work with electro-convulsive shock. Grossman (19), Deutsch and Deutsch (14), Leukel (34) and Thompson (46) reviewed the most pertinent studies in this area and suggest that the use of electro-convulsive shock applied shortly after a learning trial has the effect of disrupting learning by interfering with the consolidation process. It has also been shown that the longer the shock was delayed after learning, the less was the resulting amnesia. Although the effect of the electro-convulsive shock on previously learned behavior has had a rather controversial experimental history. Chorover and Schiller (11) and Quatermain et al (41) have presented evidence that there is a true amnestic effect for events happening within a very short period prior to the electro-convulsive shock.

Assuming that the evidence is sufficient to render the consolidation hypothesis tenable, how does consolidation relate to reminiscence? A study by Rachman and Grassi (43) helps to provide an answer to this question. These authors used four groups, all practising on the pursuit rotor for five consecutive minutes. During a four hour rest period the first group was to practise on a reversed-cue pursuit rotor for the first three minutes of the four hour rest period; the second group practiced on this reversed task from the fourth to the seventh minute and the third group practiced from the seventh to the ninth minute of the four hour rest period. The fourth group was the control and did not practice at all during the rest period. It was hypothesized by the authors that this reversed-cue task would interfere with the consolidation of memory traces and that the control group would show the greatest amount of reminiscence after rest, followed by the third and then the second experimental group. The first experimental group was expected to show the smallest amount of reminiscence. The results were in accordance with the predictions of the consolidation hypothesis indicating that consolidation provided, at least in this case, a tenable explanation whereas the inhibition theory failed to do so.

Studies by Melton (35) Jahnke and Duncan (25) and Koonce et al (30), conducted on long-term reminiscence, are other examples in which the theory of consolidation provides a logical explanation of the high degree of permanence of reminiscence gains. As mentioned earlier, the inhibitory concepts alone cannot account for reminiscence after long periods of rest.

The consolidation theory does not, however, provide all the answers. While the inhibition theory accounts for the decrease in pre-rest performance by means of accumulation of reactive inhibition, the consolidation theory does not provide any explanation for the occurence of such a decrement in pre-rest performance.

A three-factor theory of reminiscence:

It is in this context of partial failure of the inhibition theory and in the light of the definite possibilities of the consolidation hypothesis that Eysenck (16) had proposed his three factor theory of reminiscence. His theory combines the two-factor theory of inhibition and the consolidation hypothesis. According to Eysenck, reactive inhibition builds up during pre-rest practice and the pre-rest performance decreases. During the programmed rest pause, consolidation of memory traces takes place and this provides the basis of the reminiscence phenomenon. The rest pause permits the conditioned inhibition to develop. Resumption of work after the rest pause produces extinction of conditioned inhibition due to non-reinforcement. Since consolidation and work are conflicting processes, consolidation will work against the post-rest increase and this interference will produce a post-rest decrease in performance scores.

Reminiscence and discrete tasks:

The bulk of experimental evidence leading to the different theories of reminiscence has been obtained almost exclusively from one motor task: the pursuit rotor. Very few studies are directly concerned with reminiscence in a discrete motor task.

Philips (40) and Alderman (2) have presented data using the rho, a discrete motor task. Although both studies investigated a different problem, the results from their control groups have application here. Philips' control group was given four practice trials, a ten-minute rest, and another 60 practice trials. The rate of practice was set at one discrete trial every fifteen seconds. The results indicated that the reminiscence effect following the rest interval was negligible. Alderman, using a similar design, found that the control group exhibited only a slight and nonsignificant change after the interpolated rest period. In both these experiments, it is possible that the small amount of reminiscence noted was due to the distribution of practice which was not as massed as practically possible. Singer (44), using a novel, discrete basket-ball skill observed reminiscence in two of his groups; one that executed 80 consecutive throws and the other which had series of twenty consecutive throws interpolated by rest periods of five minutes. The most pertinent experimental evidence on reminiscence when using a discrete task comes from Carron (10). He hypothesized that it would be possible to demonstrate the presence of reminiscence in any motor learning task, provided that the required conditions as to the amount of massing of practice could be secured. The author utilized the peg turn, a novel, discrete motor learning task. Two of his groups practised under highly massed schedules with a delay of approximately .3 seconds between each performance trial. The interpolated rest period was two minutes. Carron found that early in practice a significant amount of reminiscence was present ($P > .05$). In the intermediate phase, when the amount of improvement was greatly reduced, no reminiscence was present, and in the performance phase, when performance was substantially completed, maximum significant ($P > .05$) reminiscence occurred.

Also related to the occurence of reminiscence is the question of whether the maximum significant amount of reminiscence occurs at the beginning or at the end of learning. In studies using continuous tasks, research has shown that amount of reminiscence is an inverse function of the degree of learning. Ammons (4), Irion (24), Buxton (9), Bell (7), and Kimble (27) indicate results in accordance with this statement. Conversely, when using a discrete task, Carron (10) indicates that maximum significant reminiscence occurred when performance was substantially completed. This study suggests that the amount of reminiscence might not follow the same decreasing pattern in the practice of a discrete task as it does in the practice of a continuous task.

Reminiscence: reliability and specificity:

In physical education the principle of specificity is well documented and refers to the inconsistency of individual differences. If applied to reminiscence, specificity, as defined above, would give valuable information about the nature of the reminiscence phenomenon.

Cratty (12), Lawther (32), Oxendine (39), and Singer (45) indicate that the abundance of research attempting to find relationships between achievement in various motor skills has tended to indicate the specificity of task performance. A person who performs well in one sport or in one skill will not necessarily do so in other sports or in other skills. There are many motor abilities, each specific to the situation in which it is applied. Henry (20, p. 126) feels that the ability to learn and perform in motor activities is extremely task specific:

> "... Individual differences in ability to profit by practice are specific to that skill and definitely do not predict the ability to improve by practice in some other skill." (20, p. 126)

In this context specificity of reminiscence would refer to the inconsistency of individual differences in reminiscing in two different tasks.

Eysenck's (16) view regarding specificity of reminiscence has a different meaning. In his three factor theory of reminiscence he has suggested that motor tasks may be arranged along a continuum and, in the situation where little or no learning occurs, reminiscence can be attributed to the dissipation of reactive inhibition. At the other end, where a great deal of learning takes place, reminiscence is better explained by the consolidation of memory traces. With this reasoning, he has concluded that reminiscence is task specific.

Of interest to the physical education teacher is whether or not reminiscence will occur consistently for individuals at different stages of the same task, and also, whether those people reminiscing in one task will reminisce to the same degree in a second task. Only one study pertinent to this particular problem exists in the literature. Leavitt and Carron (33) tested fifty high school boys on the pursuit rotor and the stabilometer. In the practice schedule, which was identical for both tasks, all subjects were given twenty 50-second trials. A five-minute interpolated rest was given after every fourth trial. They found that the reliability of individual differences in remiscence was extremely low for both tasks (.40 on the pursuit rotor and .10 on the stabilometer). The average coefficient for specificity was .18. When corrected for attenuation caused by the unreliability of individual differences, the size of the coefficients increased substantially with a mean of .90. They concluded that the amount of generality ($.90^2$) averaged 81% and, conversely, the amount of specificity was rather low (19%) over the four reminiscence periods.

CHAPTER III

RESEARCH METHODS

The purpose of this study is to determine: 1) if reminiscence does occur, under massed practice conditions, on either of two discrete tasks; 2) if there is a significant difference between the amount of reminiscence at different stages of practice on the same task, for either of two discrete tasks; 3) if there is a relationship between reminiscence scores at one stage of a discrete task and reminiscence scores at a different stage of the same task; 4) if there is a relationship between reminiscence scores in one task and reminiscence scores in a second task.

The subjects:

Forty (40) subjects participated in this study. The subjects, all second, third, and fourth year physical education students at the University of Ottawa, Ontario, volunteered to be measured on two discrete motor learning tasks. No subject was familiar with either of the two tasks.

Experimental design:

The practice schedule was identical for both tasks. Thirty-three trials were given where a trial consisted of five consecutive throws or hits. A five minute rest was interpolated following trials 8, 16, 24 and 32. They provided four measures of reminiscence. In all cases the measure of reminiscence was the difference between the last pre-rest trial and the first post-rest trial. One half of the subjects attempted the treadmill task first, followed by the squash task, and the other half practised the tasks in reverse order. For each subject, the two tasks were administered two days apart. The testing period extended over a period of four weeks.

The treadmill task:

The subject was situated in front of the treadmill (see fig. 1). Forty-eight inches separated the subject and the front edge of the treadmill. A wall was situated nineteen inches behind the back edge of the treadmill. The width of the treadmill was 23½ inches. Six horizontal lines, each five inches apart on the belt of the treadmill, provided a target 25 inches long and 23½ inches wide. The middle section was given a value of five points, the two sections adjacent to the middle section were assessed a value of three points, and the two outer areas were given values of one point.

The treadmill rotated at a speed of twenty revolutions a minute (one revolution every three seconds). The target would thus appear once every three seconds. The upper surface of the treadmill was moving toward the subject. The subject had a box of tennis balls within reach, sitting on a table to his right or left, depending on the handedness of the subject.

Procedures:

The task consisted of throwing a tennis ball in an underhand manner, off the wall, in such a way that it rebound on to the moving treadmill. The subject was required to make forty consecutive throws. A throw was to be executed each time the target reappeared. In most cases the subjects used the same ball for all forty throws,the ball rebounding directly to the subject. If the ball was lost, the subject was instructed to pick up another ball from the box sitting next to him. If such a situation presented itself the subject had been previously instructed to lose as little time as possible and to start throwing at the instructed rhythm.

The experimenter called out the score obtained for each throw. This score was recorded by an assistant. After the completion of the forty throws, the subject was told to stop. Then the treadmill was stopped in such a position that the target could be seen in the upper back half of the treadmill. A stop-watch was started and the subject was asked to enter an adjacent room and rest for exactly five minutes. The subject was instructed not to talk about the task with other subjects. After the rest period, the subject resumed the task, making his first throw on the first reappearance of the target.

The complete test was composed of five sessions interpolated by five minute rest periods. The first four sessions consisted of forty consecutive throws while the fifth session had only five throws.

Scoring of the treadmill task:

Each throw was scored 0, 1, 3 or 5. Balls landing on a dividing line were scored as the highest of the two values. The forty scores were divided into eight trials. The first trial grouped the first five consecutive throws, the second trial grouped the five following throws and so on. Hence the series of forty (40) consecutive throws was divided into eight trials in which the score of one trial was the total score of the five throws comprising this trial.

Thirty-three trials were given and a five minute rest was interpolated following trials 8, 16, 24 and 32. Four measures of reminiscence were obtained by subtracting the last trial before the rest period from the first trial after the rest period every time a rest was introduced: score differences between trials 9 and 8, 17 and 16, 25 and 24, 33 and 32, represented the four measures of reminiscence obtained.

The squash task:

The subject was placed in a squash court facing a corner at a distance of 140 inches and 70 inches from the walls adjacent to the corner (see fig. 2). On the floor a target was fixed on which three concentric circles were drawn. The radii of the circles were respectively 5 inches, 10 inches, and 15 inches. The centre of the target was 66 inches away from the front wall and 53 inches away from the side wall. The inner circle was assessed a value of five points and the middle and outer circles were given a value of three points and one point respectively.

Procedures:

The subject had a box of tennis balls within reach situated on a table to his right or left, depending on the handedness of the subject. A sound stimulus (buzzer) was pre-recorded at a cadence of one every three seconds. The subject was instructed to hit a ball every time he heard the buzzer. The task consisted of hitting a ball with a regulation paddle-ball racquet in such a manner that the ball would hit both walls before landing on the target. For this task, the same pattern was adopted as in the treadmill task; thirty-three practice trials were given where a trial consisted of five consecutive hits. A five-minute rest was interpolated following trials 8, 16, 24 and 32.

Subjects were instructed individually as they came to be tested. The subject was instructed in advance to listen to the first two buzzers and then start hitting every time the buzzer sounded. After every throw, the experimenter called out the score obtained. The score was recorded by an assistant. After the completion of the forty hits the subject was told to stop. A stop-watch was then started and the subject was instructed to enter an adjacent room and rest for five minutes. The subject was instructed not to talk about the task with other subjects. Following the rest period the subject resumed the same procedure with the exception that he would start hitting the first time he heard the sound stimulus.

Similar to the treadmill task, the complete test for the squash task consisted of five sessions interpolated by five minute rest periods. The first four sessions were composed of forty consecutive hits while the fifth session had only five hits.

Scoring of the squash task:

Exactly the same procedure in scoring the squash task was used as in scoring the treadmill task. Each hit was scored 0, 1, 3 or 5. Any ball landing on a line was given the higher of the two values. The series of forty (40) consecutive hits was divided into eight trials. The score of one trial was the total score of the five hits comprising that trial.

Thirty-three practice trials were given in the squash task and a five-minute rest was interpolated following trials 8, 16, 24 and 32. Four measures of reminiscence for the squash task were obtained through the same procedure used in the treadmill task i.e., by subtracting the last pre-rest trial from the first post-rest trial.

Treatment of the data:

a) Reliability of the tasks:

The reliability of each of the two discrete tasks was established by correlating two consecutive trials for each session. Eta coefficients were computed between trials 7-8, 9-10, 15-16, 17-18, 23-24, 25-26, and 31-32. The obtained coefficients were averaged in order that the reliability, for each task, could be expressed as a single coefficient.

b) Transfer between tasks:

Since one half of the subjects undertook the treadmill task first and the second half of the subjects undertook the squash task first, the possibility of transfer from one task to another existed. To test for this possible confounding variable, two t tests for differences between non-correlated means (13, p. 361) were calculated. The t tests compared the means of those subjects who took the treadmill task first with those subjects undertaking the same task second. The squash task was treated in a similar manner.

c) Hypothesis I:

No reminiscence will occur, under massed practice conditions on either of two discrete tasks. Four individual t tests for differences between correlated paired measures (13, p. 364) were calculated for each of the two discrete tasks.

d) Hypothesis II:

There is no significant differences between the amount of reminiscence at different stages of practice on the same task, for either of two discrete tasks.

A single factor analysis of variance for repeated observations on the same subjects was calculated for each discrete task. In both tasks the four measures of reminiscence served as the treatment effects (four repeated observations).

e) Hypothesis III:

There is no relationship between reminiscence scores at one stage of a discrete task and reminiscence scores at a different stage of the same task. Intra-individual reliability was investigated in two separate analyses: 1) A single reliability coefficient was obtained using a reliability formula proposed by Winer (49, p. 131), utilizing a single factor analysis of variance for repeated observations. 2) Intercorrelations (Pearson r) were calculated (13, p. 126) for each stage with all other stages of the same task. The average coefficient was also computed.

f) Hypothesis IV:

There is no relationship between reminiscence scores in one task and reminiscence scores in a second task. Intercorrelations (Pearson r) were calculated between the reminiscence scores obtained at the different stages of one task and reminiscence scores obtained at the different stages of the second task. The average coefficient was also computed.

Figure 1. THE TREADMILL TASK

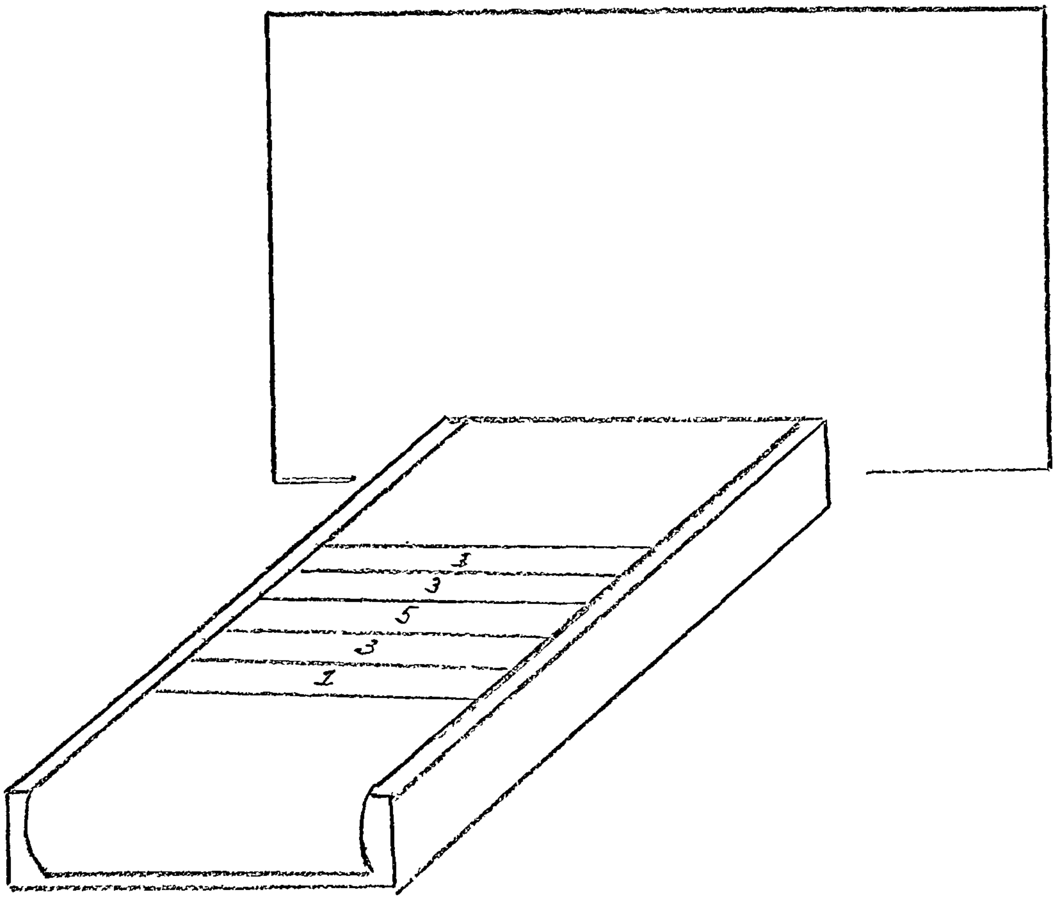
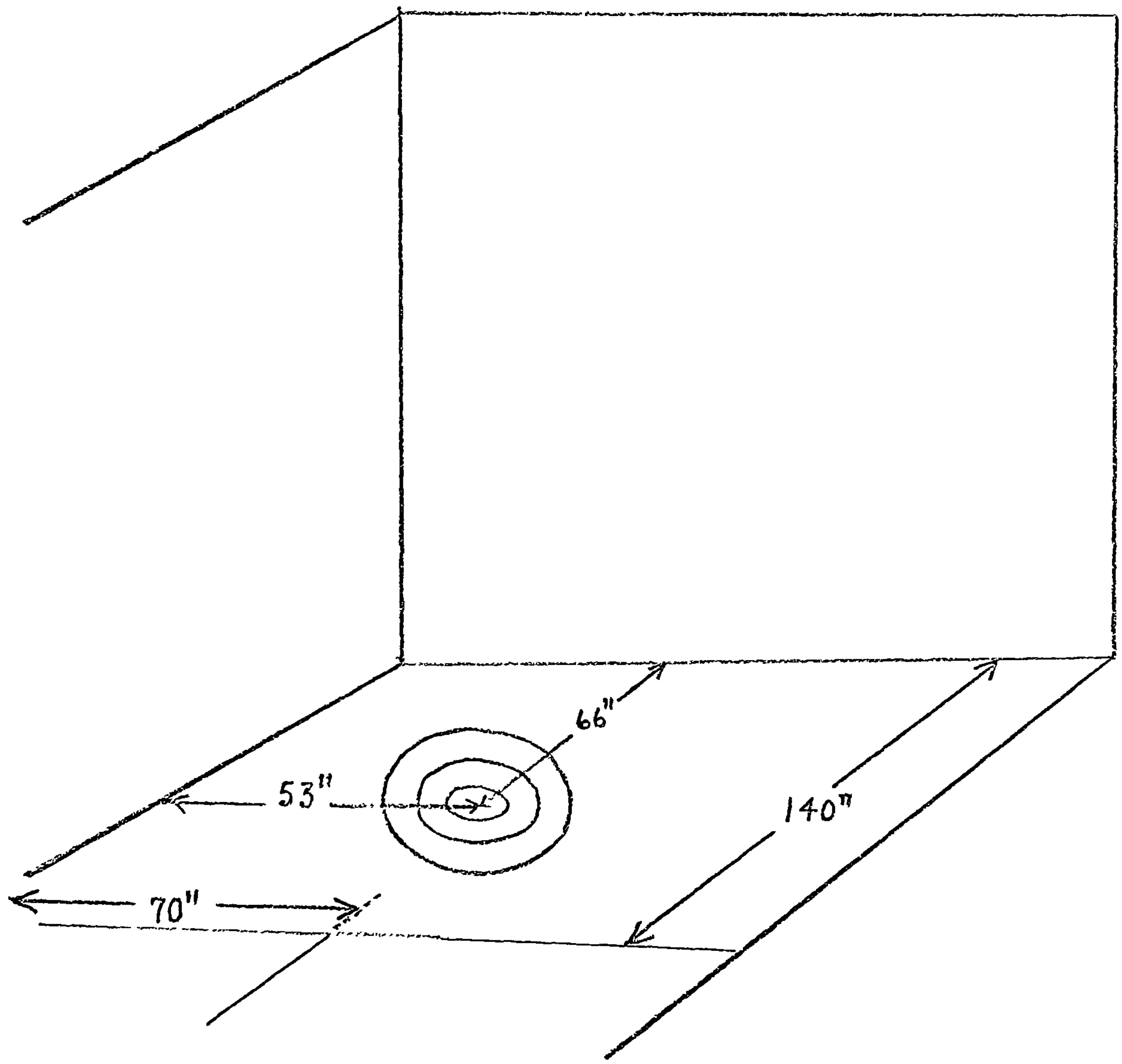


FIGURE 2. THE SQUASH TASK



CHAPTER IV

RESULTS

In this chapter the results will be presented in the following order: firstly, data regarding the reliability of both tasks will be presented under the heading "task reliability". Results depicting transfer effects will be reported under the heading "inter-task transfer". Data concerning the four hypotheses under investigation in this study will follow and will be reported under separate headings.

Task reliability:

Table 1 presents the task reliability coefficients obtained between the last two pre-rest trial scores and between the first two post-rest trial scores for each session, and for each of the two tasks. The average coefficients are also presented in table 1.

Table 2 indicates the mean scores for all 33 trials, for both tasks.

Table 3 reports the total scores for each session, averaged for the 40 subjects. The constant increase in performance from session to session was thought to be an additional, thought slight, indication of the reliability of the two tasks. Also reported in this table are the standard deviations expressing the variability of the 320* trial scores included in each session.

Inter-task transfer:

No significant differences were evident between the group that took the treadmill task first (N = 20; Mean = 60.95) and the group that took the same task second (N = 20; Mean = 53.40). The calculated t value obtained was 1.2760 non-significant at the .05 level. When the group that took the squash task first was compared with the group that took the same task second, the means were respectively 36.05 and 33.95, and the obtained t value was .3505, again non-significant at the .05 level.

Hypothesis one:

No reminiscence will occur, under massed practice conditions, on either of two discrete tasks.

Table 4 presents the results from a series of t tests calculated on the values for the last pre-rest trial and the first post-rest trial. The values expressed in Table 4 were obtained for the treadmill data.

Table 4 indicates that all the t values were significant at the .01 level, with one exception, that exception

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* To complete one session, each subject had to be tested on 8 consecutive trials, and 40 subjects underwent this procedure; hence, 8 trial scores x 40 subjects = 320 trial scores.

being significant at the .05 level. Such results indicate that statistically significant amounts of reminiscence occurred at all four stages of practice in the treadmill task.

Table 5 presents the results from a series of t tests calculated on the values for the last pre-rest trial and the first post-rest trial. The values expressed in Table 5 were obtained for the squash task.

All t values were significant at the .01 level indicating that significant amounts of reminiscence appeared at all four stages of practice in the squash task.

Hypothesis two:

There is no significant difference between the amount of reminiscence at different stages of practice of the same task, in either of two discrete tasks.

Table 6 shows the results of a single factor analysis of variance for repeated observations on the same subjects. The repeated observations were the reminiscence scores taken at the four different stages of practice on the treadmill task.

These results indicate that, for the treadmill task, there is no significant difference in the amount of reminiscence found at any of the four different stages.

Table 7 reports the results obtained when similar statistical treatment was applied to the reminiscence scores obtained from the squash task. As in the treadmill task, there were no significant differences noted between the amount of reminiscence found at any of the four different stages.

Hypothesis three:

There is no relationship between reminiscence scores at one stage of practice on a discrete task and reminiscence scores at a different stage of practice on the same task.

Table 8 indicates the intercorrelations between the four series of reminiscence scores obtained at each of the four stages of practice on the treadmill task.

Table 9 shows the intercorrelations between the four series of reminiscence scores obtained at every one of the four stages of practice in the squash task.

The averages of the mean coefficients of correlation are respectively .1391 and .1293 for the treadmill task and for the squash task. Such results indicate very low reliability of individual differences in reminiscing from one stage to another stage within the same task. When using the reliability formula proposed by Winer (49, p. 131) one single reliability coefficient was obtained for each of the two tasks. These coefficients were even lower than the two averages of the mean coefficients presented above (.04 for the treadmill task and .02 for the squash task).

Hypothesis four:

There is no relationship between reminiscence scores in one task and reminiscence scores in a second task.

Table 10 reports the intercorrelations between the reminiscence scores obtained at the different stages of one task and reminiscence scores obtained at the different stages of the second task.

These results indicate that the generality is very low ($.0997^2$) = 1%. Conversely the specificity is very high (99%).

TABLE 1 --- ETA RELIABILITY COEFFICIENTS (n=40)

TRIALS CORRELATED	(7-8)	(9-10)	(15-16)	(17-18)	(23-24)	(25-26)	(31-32)	$\bar{r}^{+}$
T*	.8060	.4117	.4843	.7080	.5882	.3309	.5419	.5649
S **	.5948	.3334	.5120	.5959	.5586	.5286	.5012	.5154

+ = Average coefficient

* = Treadmill task; ** = Squash task

TABLE 2 --- MEAN PERFORMANCE SCORES, BY TRIALS, FOR BOTH TASKS (N=40).

THE TREADMILL TASK:

T_1	4.775	T_9	10.225	T_{17}	10.350	T_{25}	12.200		
T_2	9.750	T_{10}	10.600	T_{18}	9.950	T_{26}	10.250		
T_3	7.900	T_{11}	10.100	T_{19}	11.825	T_{27}	11.150		
T_4	7.300	T_{12}	8.550	T_{20}	10.950	T_{28}	11.000		
T_5	6.950	T_{13}	9.350	T_{21}	9.225	T_{29}	12.900		
T_6	7.000	T_{14}	9.025	T_{22}	9.400	T_{30}	11.500		
T_7	7.750	T_{15}	8.450	T_{23}	8.950	T_{31}	11.250		
T_8	7.075	T_{16}	7.725	T_{24}	8.475	T_{32}	8.525	T_{33}	11.1

THE SQUASH TASK:

T_1	2.525	T_9	6.550	T_{17}	7.200	T_{25}	8.700		
T_2	2.925	T_{10}	5.725	T_{18}	7.650	T_{26}	7.075		
T_3	4.325	T_{11}	6.200	T_{19}	5.900	T_{27}	8.850		
T_4	5.500	T_{12}	6.125	T_{20}	8.175	T_{28}	6.975		
T_5	5.150	T_{13}	6.075	T_{21}	7.350	T_{29}	7.750		
T_6	4.875	T_{14}	6.075	T_{22}	7.750	T_{30}	7.325		
T_7	5.100	T_{15}	6.625	T_{23}	6.150	T_{31}	7.475		
T_8	4.650	T_{16}	5.200	T_{24}	5.575	T_{32}	5.800	T_{33}	7.25

TABLE 3 --- INCREASE IN PERFORMANCE EXPRESSED BY THE SESSION TOTAL SCORE (SUM OF EIGHT CONSECUTIVE TRIAL SCORES), AVERAGED FOR THE 40 SUBJECTS

THE TREADMILL TASK:	SESSIONS			
	I	II	III	IV
Average session total scores	58.50	74.025	79.1250	88.775
Standard deviations	4.4315	4.5307	4.6581	4.5051
THE SQUASH TASK:				
Sessions	I	II	III	IV
Average session total score	35.5	48.575	55.75	59.95
Standard deviations	3.8566	3.9726	4.3623	4.3105

TABLE 4 --- t VALUES BETWEEN LAST PRE-REST TRIAL AND FIRST POST-REST TRIAL COMPUTED AT EVERY STAGE OF PRACTICE IN THE TREADMILL TASK

	OBTAINED t VALUE	LEVEL OF SIGNIFICANCE*
Between trials 8 and 9	4.1232	$t > .01$
Between trials 16 and 17	2.40993	$t > .05$
Between trials 24 and 25	5.2098	$t > .01$
Between trials 32 and 33	3.5528	$t > .01$

* The t value required for significance at the .05 level was 2.0221

The t value required for significance at the .01 level was 2.704

TABLE 5 --- t VALUES BETWEEN LAST PRE-REST TRIAL AND FIRST POST-REST TRIAL COMPUTED AT EVERY STAGE OF PRACTICE IN THE SQUASH TASK

	OBTAINED t VALUE	LEVEL OF SIGNIFICANCE*
Between trials 8 and 9	3.4825	$t > .01$
Between trials 16 and 17	2.7520	$t > .01$
Between trials 24 and 25	4.3406	$t > .01$
Between trials 32 and 33	2.9654	$t > .01$

* THE t VALUE REQUIRED FOR SIGNIFICANCE AT THE .01 LEVEL WAS 2.704

TABLE 6 --- SINGLE FACTOR ANALYSIS OF VARIANCE FOR REPEATED OBSERVATIONS ON THE SAME SUBJECTS: TREADMILL TASK

SOURCE OF VARIANCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO
Stages	34.9998	3	11.6666	0.5597*
Subjects	971.9000	39	24.9205	
Interaction	2439.0000	117	20.8462	
Total	3445.9000	159		

* The F value required for significance at the.05 level was 3.95

TABLE 7 --- SINGLE FACTOR ANALYSIS OF VARIANCE FOR REPEATED OBSERVATIONS ON THE SAME SUBJECTS: SQUASH TASK

SOURCE OF VARIANCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARES	F RATIO
Stages	43.4750	3	14.4917	0.8365*
Subjects	616.4750	39	15.8071	
Interaction	2027.0300	117	17,3250	
Total	2686.9800	159		

* The F value required for significance at the .05 level was 3.95

TABLE 8 --- CORRELATIONAL COEFFICIENTS FOR REMINISCENCE SCORES FROM ONE STAGE TO ANOTHER: TREADMILL TASK (N=40)

STAGES OF PRACTICE	I	II	III	IV	$\bar{r}$*
I		.3314	-.2240	.0061	.1878
II	.3314		-.0033	.2003	.1781
III	-.2240	-.0033		-.0438	.0798
IV	.0061	.2003	-.0438		.0798
$\bar{r}$*	.1878	.1781	.0798	.0798	.1391**

* = mean coefficients of correlation

** = the average of the mean coefficients

TABLE 9 --- CORRELATIONAL COEFFICIENTS OF INDIVIDUAL DIFFERENCES IN REMINISCING FROM ONE STAGE TO ANOTHER: SQUASH TASK (N=40)

STAGES OF PRACTICE	I	II	III	IV	$\bar{r}$*
I		-.0068	.1046	.0925	.0600
II	-.0068		-.2304	-.1712	.1391
III	.1046	-.2304		.1716	.1684
IV	.0925	-.1712	.1716		.1489
$\bar{r}$*	.0600	.1391	.1684	.1489	.1293**

* = mean coefficients of correlation

** = the average of the mean coefficients

TABLE 10 --- CORRELATIONAL COEFFICIENTS OF INDIVIDUAL DIFFERENCES IN REMINISCING FROM ONE TASK TO THE OTHER (N=40)

STAGES OF PRACTICE	I_t++	II_t	III_t	IV_t	$\bar{r}$*
I_s+	.0315	-.0137	.1811	-.1626	.0898
II_s	-.1439	.1119	-.2168	.0811	.1293
III_s	-.0425	-.0531	.0943	.1784	.0898
IV_s	.0572	-.1218	.0142	.1378	.0798
$\bar{r}$*	.0699	.0699	.1200	.1391	.0997**

* = mean coefficients of correlation

** = average of the mean coefficients

\+ = squash task

++ = treadmill task

CHAPTER V

DISCUSSION OF THE RESULTS

Hypothesis one:

No reminiscence will occur, under massed practice conditions, on either of two discrete tasks.

The results obtained indicate that a significant amount of reminiscence occurred at each stage of the two discrete tasks employed in this study. Thus, it appears that the five minute interpolated rest periods were long enough to produce a reminiscence effect. These findings support those reported in previous investigations (4, 10, 28, 33, 44). It should be noted that all of the above studies were conducted on continuous tasks, with the exception of that of Carron (10) and Singer (44) which dealt with discrete tasks. The possibility still exists however, that even greater reminiscence might have been obtained had the interpolated rest intervals been of longer duration; i.e., eight to ten minutes as suggested by Kimble and Horenstein (26). However, this possibility is somewhat unlikely in that the latter author's study utilized a continuous task, the pursuit rotor, and thus a greater degree of massing of practice was undoubtedly obtained. This fact suggests that a longer rest interval would be required in order to dissipate the greater degree of reactive inhibition that would have built up. This argument is tenable only to the extent that reactive inhibition is indeed a valid explanation of the phenomenon under consideration. In fact, different possible explanations of the occurence of reminiscence can be provided.

According to the inhibition theory, there should be a late pre-rest decrement in performance due to the accumulation of reactive inhibition. During the five-minute interpolated rest, the major part of reactive inhibition would dissipate and the performance after rest would be better, hence explaining the occurence of reminiscence. Table 2 shows that the data obtained on the two discrete tasks is compatible with theoretical expectations based on the inhibition theory. It should be noted, however, that not all subjects experienced reminiscence at the four stages of practice. This could possibly be explained by one of two factors: a) the low reliability of the tasks; b) the conditions of practice, though massed as much as practically possible, were not massed to the extent that all subjects experienced a decrease in performance toward the end of each session. Nevertheless, it is interesting to note that neither of those factors prevented the majority of subjects from experiencing a reminiscence effect upon resumption of practice.

Another possible explanation for the occurence of reminiscence is the interpretation offered by Eysenck (16).

This author suggested that in a motor learning task in which a great deal of learning occurs, the presence of reminiscence could be explained by the consolidation of memory traces. Rachman and Grassi (43) have shown in a study using the pursuit rotor that consolidation very possibly influenced the amount of reminiscence obtained. Since the two tasks in the present study were novel and since relatively large amounts of learning did take place, it is certainly possible that a consolidation factor could have accounted for the appearance of reminiscence effects, especially early in practice.

Nevertheless, whichever theory the reader is inclined to support, proper massing conditions appear to be of prime importance with respect to producing a reminiscence effect in discrete tasks. While Carron (10) and Singer (44) noted significant reminiscence effects in discrete tasks, Philips (40) and Alderman (2) obtained negligible amounts of reminiscence utilizing similar tasks. The reader should note however that the conditions of practice in the latter two studies were not as massed as possible and thus may have contributed to the lack of reminiscence effects.

Hypothesis two:

There is no significant difference between the amount of reminiscence at different stages of practice in the same task, for either of two discrete tasks.

The findings of this study do not agree with those previously presented with respect to the amount of reminiscence occurring at various stages throughout the learning of a motor task. Whereas reminiscence in discrete tasks has been found to be highest in the later stages of learning (10), subjects performing on continuous tasks appear to experience greatest reminiscence in the early stages of learning (4, 6, 9, 24). In this study, no significant differences were noted with respect to the stage at which reminiscence effects appeared; i.e., the reminiscence effect was found to be relatively stable throughout the learning of the two discrete tasks.

Although the performance scores did not approach an asymptote, most of the learning took place early in practice in each of the two tasks (Table 3). If, as suggested by Eysenck, consolidation of memory traces is the reminiscence-producing mechanism when a great deal of learning takes place, and reactive inhibition is the reminiscence-producing factor where little learning occurs, it can be said that the nature of the reminiscence-producing mechanisms did not influence the amount of reminiscence obtained at each stage of the two discrete tasks involved in this study. On the other hand, if reactive inhibition was the single causal factor with respect to the appearance of reminiscence, its effect was the same throughout the length of practice in both tasks.

Hypothesis three:

There is no relationship between reminiscence scores at one stage of a discrete task and reminiscence scores at a different stage of the same task.

The correlation coefficients calculated for measures of reminiscence in each of the two tasks are extremely low (Tables 8 and 9) and all non significant ($P > .05$), indicating that individuals were very inconsistent in their reminiscence scores from session to session on the same task. These findings agree with those presented earlier by Leavitt and Carron (33). Utilizing the pursuit rotor and the stabilometer these authors found extremely low intra-task reliabilities with respect to reminiscence performance from one stage to another.

In the present study, the low reliability of the tasks may have been partially responsible for the appearance of the low coefficients in question. Another possible explanation for the low coefficients is the high degree of difficulty of both tasks. This was indicated in the raw scores in that no subject obtained a maximum score on any one of the 33 trials.

However, it should be pointed out that in both tasks average performance increased regularly from session to session (Table 3). Also, standard deviations were stable from one session to the other (Table 3). Such evidence suggests that performance scores were relatively stable in both tasks.

From a theoretical point of view, the individual inconsistencies noted may well have been created by the change in the nature of the reminiscence-producing mechanisms from the beginning to the end of practice of the same task. It is not inconceivable to think as Eysenck (16) infers, that early in practice (where a great deal of learning takes place) reminiscence is the result of consolidation of memory traces, and later in practice (where little learning occurs) reminiscence is better explained by the dissipation of reactive inhibition. However, if such were the case, the high unreliability obtained between the different measures of reminiscence suggests that individuals were affected differently in that if all subjects were affected in the same way, high reliability coefficients would have resulted. Hence the individual inconsistencies in reminiscence cannot fully be accounted for by the fact that different causal factors operate at different times during the learning of a discrete motor task. Leavitt and Carron (33) offer the following with respect to the unreliability of individual differences in reminiscence:

> "Apparently, there is some inherent variability within the individual's ability to accumulate and /or consolidate memory traces from previous practice from any one instant to another." (33, p. 282)

Until more research has been attempted in this area, this concept of "inherent variability" will have to be accepted, especially in light of the result of this study and the previous work of Leavitt and Carron.

Hypothesis four:

There is no relationship between reminiscence scores in one task and reminiscence scores in a second task.

In examining the fourth problem presented in this study, that of specificity of individual difference in reminiscence, it was found that individuals were very inconsistent in their reminiscence scores from one task to another. When reminiscence scores obtained from the 40 subjects at each stage of one task were compared with the 40 reminiscence scores obtained at each stage of the second task, 16 combinations were possible. None of the 16 coefficients of correlation differed significantly from zero; the mean was .0997. Thus the amount of generality is practically nil and the amount of specificity is very high over the four reminiscence stages. Such results indicate that, for the two tasks used in this study, reminiscence scores obtained in one task were not related to reminiscence scores obtained in the second task.

It should be noted, however, that due to the low coefficients previously reported for intra-task reliability, the coefficients of correlation representing relationships across tasks (specificity) can only be speculative.

In the context used by Eysenck, motor tasks could be arranged along a continuum and, as noted earlier, if little learning occurs, reminiscence may well be attributed to the dissipation of reactive inhibition and where much learning takes place reminiscence may be explained by the consolidation of memory traces. Hence, specificity implies that the reminiscence-producing mechanisms operative in each task are different. If those mechanisms are in fact different for the two tasks used in this study, it could help explain the low coefficients of correlation obtained when reminiscence scores of one task were correlated with reminiscence scores in the second task. However, the two tasks used in this study appear similar in that both are discrete accuracy tasks. Also, the greatest amount of learning took place from session one to session two for both tasks (51% for the treadmill task and 58.8% in the squash task), another possible indication of the similarity of the two tasks. Following Eysenck's reasoning, the two tasks should be very close on the learning continuum, at least when the first mesure of reminiscence was taken, and therefore, the causal factors of reminiscence should be similar for both tasks. When reminiscence scores obtained at the first stage of one task were compared with the ones at the first stage of the other task, the coefficient was .0315. This indicates that the hypothetical construct of consolidation did not affect performers the same way in each of the two tasks. It is not inconceivable to think that when changing from one task to the other it became more difficult for some subjects and easier for others to consolidate the information presented in the learning experience. It is also possible that, depending on the sill to be learned, different ways of consolidating are required and subjects' ability to consolidate may vary with the nature of the tasks.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Forty physical education students volunteered to be tested on two discrete motor learning tasks. The practice schedule was identical for both tasks. Thirty-three practice trials were given in which a trial consisted of five consecutive throws or hits depending on the task. A five-minute rest was interpolated following trials 8, 16, 24 and 32. This provided four measures of reminiscence. In all cases the measure of reminiscence was the difference between the last pre-rest trial and the first post-rest trial. One half of the subjects were tested first on the treadmill task and then on the squash task, the other half being tested in reverse order.

It was found that for each of the two tasks a significant amount of reminiscence occurred after each of the four interpolated rest periods. A single factor analysis of variance for repeated observations indicated no significant difference between the amount of reminiscence at one stage and the amount of reminiscence at any other stage of the same task. A mean correlation of .13 expressed the low reliability of individual differences in reminiscing from one stage to another stage of the same task. When reminiscence scores were compared across tasks, very high specificity was found.

As a result of the findings of this investigation, and within the limitations of the study, the following conclusions are drawn:

1. A significant amount of reminiscence was obtained, at all stages, on two discrete motor learning tasks.

2. The amount of reminiscence obtained at one stage of practice did not differ significantly from the amount obtained at any other stage on either of two discrete motor learning tasks.

3. Individual reliability, with respect to reminiscence, was found to be very low. Individuals who demonstrated relatively large amounts of reminiscence at one stage of practice were not the same individuals who demonstrated large amounts of reminiscence at a later stage of practice in the same task.

4. Reminiscence was found to be task-specific. Individuals who reminisced in one task did not maintain their relative position in reminiscing in the second task.

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APPENDIX

SCORE FOR THE LAST PRE-REST AND THE FIRST POST-REST TRIALS AT EVERY ONE OF THE FOUR STAGES: THE TREADMILL TASK

S*	I		II		III		IV	
1	5	11	5	10	11	10	1	11
2	7	11	2	8	10	11	4	17
3	5	8	11	4	4	2	10	6
4	2	12	6	18	9	9	3	8
5	6	3	6	4	4	13	9	7
6	1	5	0	6	5	8	4	6
7	9	10	6	13	5	13	5	11
8	0	3	3	5	8	11	4	13
9	3	12	1	6	1	12	11	10
10	13	17	12	10	12	15	10	14
11	1	13	6	17	7	19	9	12
12	9	14	8	4	15	10	13	15
13	1	5	13	16	6	11	12	15
14	12	13	7	10	1	10	2	0
15	13	9	1	6	7	16	6	8
16	8	13	5	11	4	5	9	15
17	8	19	8	14	7	3	8	17
18	10	13	5	13	10	14	7	11
19	15	14	9	12	9	14	5	15
20	14	15	11	16	14	14	9	14
21	7	4	15	13	15	13	13	14
22	6	6	3	8	3	12	12	14
23	4	10	6	2	4	5	12	9

S* Subjects

S*	I		II		III		IV	
24	4	8	12	15	9	14	7	14
25	9	10	11	11	8	14	2	10
26	8	12	9	11	9	16	11	14
27	6	4	4	8	10	17	7	10
28	7	16	11	14	7	11	13	13
29	6	4	14	7	12	17	10	8
30	15	9	16	11	2	13	6	15
31	10	6	14	5	4	8	9	10
32	13	9	16	10	9	9	9	6
33	3	11	4	14	10	6	6	6
34	11	4	9	17	17	21	17	17
35	4	14	6	5	13	17	4	6
36	13	21	2	8	9	16	15	13
37	9	9	6	7	14	19	10	9
38	7	17	11	12	7	10	15	7
39	7	8	9	13	15	16	14	10
40	2	7	6	10	13	14	10	14

S* Subjects

SCORES FOR THE LAST PRE-REST AND THE FIRST POST-REST TRIALS AT EVERY ONE OF THE FOUR STAGES: THE SQUASH TASK.

S*	I		II		III		IV	
1	0	1	0	4	0	10	6	6
2	2	7	5	1	6	8	2	5
3	5	1	2	9	10	10	12	9
4	5	0	7	4	9	11	10	12
5	1	5	3	0	1	6	7	7
6	2	0	6	7	1	7	5	8
7	2	9	3	15	2	14	8	13
8	10	9	1	6	14	16	2	7
9	0	3	5	3	4	7	2	6
10	10	19	14	12	16	17	11	12
11	7	9	9	5	4	12	7	9
12	3	2	5	4	8	10	7	10
13	13	16	6	12	7	9	5	5
14	4	6	3	0	0	1	4	0
15	6	6	10	9	9	12	11	15
16	3	8	4	11	5	8	8	9
17	4	5	2	6	4	5	0	3
18	5	6	5	5	7	3	6	6
19	12	14	10	12	5	15	10	6
20	5	6	12	7	1	14	0	11
21	7	11	9	15	9	17	11	12
22	3	7	6	11	2	7	3	1
23	0	5	4	5	7	7	8	8

S* Subjects

S*	I		II		III		IV	
24	6	9	1	4	6	5	2	12
25	9	6	9	11	4	13	7	5
26	0	1	0	6	1	4	0	5
27	3	10	7	19	12	8	4	5
28	7	13	6	9	6	9	8	6
29	5	4	9	8	1	3	10	11
30	3	0	2	1	4	6	0	4
31	9	10	2	7	4	6	1	11
32	4	7	5	3	8	14	13	15
33	10	11	1	10	10	8	6	8
34	1	4	0	6	4	0	1	0
35	5	1	12	16	12	9	7	6
36	3	11	10	3	11	12	10	13
37	3	5	6	5	1	9	8	5
38	0	4	3	5	0	4	1	7
39	1	6	4	8	3	6	2	1
40	8	4	0	11	0	5	7	1

S* Subjects

REMINISCENCE SCORES OBTAINED AT THE FOUR DIFFERENT STAGES OF PRACTICE: THE TREADMILL TASK

S*	I	II	III	V
1	7	5	1	10
2	4	6	1	13
3	-3	7	-2	- 4
4	10	12	0	5
5	-3	-2	9	-2
6	4	6	3	2
7	1	7	8	6
8	3	2	3	9
9	9	5	11	-1
10	4	-2	3	4
11	12	11	12	3
12	5	-4	-5	2
13	4	3	5	3
14	1	3	9	-2
15	-4	5	9	2
16	5	6	1	6
17	11	6	-4	9
18	3	8	4	4
19	-1	3	5	10
20	1	5	0	5
21	-3	-2	-2	1
22	0	5	9	2
23	6	-4	1	-3

S* Subjects

S*	I	II	III	IV
24	4	3	5	7
25	1	0	5	8
26	4	2	7	3
27	-2	4	7	3
28	9	3	4	0
29	-2	-7	5	-2
30	-6	-5	11	9
31	-4	-9	4	1
32	6	-6	0	-3
33	8	10	-4	0
34	-7	8	4	0
35	10	1	4	2
36	8	6	7	-2
37	0	1	5	-1
38	10	1	3	-8
39	1	4	1	-4
40	5	4	1	4

S* Subjects

REMINISCENCE SCORES OBTAINED AT THE FOUR DIFFERENT STAGES OF PRACTICE: THE SQUASH TASK

S*	I	II	III	IV
1	1	4	10	0
2	5	-4	2	3
3	-4	7	0	-3
4	-5	-3	2	2
5	4	-3	5	0
6	-2	1	6	3
7	7	12	12	5
8	-1	5	2	5
9	3	-2	3	4
10	9	-2	1	1
11	2	-4	8	2
12	-1	-1	2	3
13	3	6	2	0
14	2	-3	1	-4
15	0	-3	3	4
16	5	7	3	1
17	1	4	1	3
18	1	0	-4	0
19	2	2	10	-4
20	1	-5	13	11
21	4	6	8	1
22	4	5	5	-2
23	5	1	0	0

S* Subjects

S*	I	II	III	IV
24	3	3	-1	10
25	-3	2	9	-2
26	1	6	3	5
27	7	12	-4	1
28	6	3	3	-2
29	-1	-1	2	1
30	-3	-1	2	4
31	1	5	2	10
32	3	-2	6	2
33	1	9	-2	2
34	3	6	-4	-1
35	-4	4	-3	-1
36	8	-7	1	3
37	2	-1	+8	-3
38	4	2	4	6
39	5	4	3	1
40	-4	11	-5	-6

S* Subjects