

OSP-2
1907

THE EFFECTS OF OVERLEARNING AND TASK
DIFFICULTY ON THE RETENTION AND RELEARNING OF A
GROSS MOTOR TASK

BY

MARILYN EDITH YEATES
B.Sc., University of Ottawa, 1973

THESIS

Submitted to the School of Graduate Studies
in partial fulfillment of the requirements
for the degree of Master of Science in Kinanthropology
in the School of Physical Education and Recreation,
University of Ottawa, 1974

Ottawa, Ontario



UMI Number: EC55520

INFORMATION TO USERS

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleed-through, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

UMI[®]

UMI Microform EC55520
Copyright 2011 by ProQuest LLC
All rights reserved. This microform edition is protected against
unauthorized copying under Title 17, United States Code.

ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

ACKNOWLEDGEMENTS

The author wishes to acknowledge the invaluable assistance of Dr. Richard Mosher. His guidance, encouragement and availability for discussion were greatly appreciated. In addition, the author would like to thank Dr. Martin Cooper for his patience and help in the statistical analysis.

Special thanks is also expressed to the staff and students of Blackburn Hamlet Catholic School and Emily Carr Middle School for their cooperation.

TABLE OF CONTENTS

CHAPTER		Page
I	INTRODUCTION	1
	Need for the study	3
	Purpose of the study	6
	Hypotheses	7
	Definition of terminology	8
	Limitations of the study	10
II	REVIEW OF RELATED LITERATURE	12
	Retention of motor skills	12
	Overlearning of motor skills	15
III	RESEARCH METHODS	21
	The subjects	21
	Experimental design	22
	The stabilometre	24
	Procedures	25
	Treatment of the data	27
IV	RESULTS	29
	Hypotheses one and three	29
	Hypotheses two and four	32
V	DISCUSSION OF THE RESULTS	35
VI	SUMMARY AND CONCLUSIONS.....	45
	Summary	45
	Conclusions	47
	REFERENCES CITED	48
APPENDIX A:	STANDARD INSTRUCTIONS FOR THE	
	SUBJECTS	51
B:	RAW DATA	52

LIST OF TABLES

TABLE		Page
1	Experimental Design	23
2	Mean Absolute Retention Scores and Standard Deviations for Each Overlearning Group and Both Difficulty Levels	30
3	Two Factor Analysis of Variance for the Variables Overlearning and Task Difficulty: Absolute Retention Scores	31
4	Simultaneous Confidence Intervals From the Tukey Test for all Possible Comparisons Between Overlearning Levels: Absolute Retention Scores	32
5	Mean Values for Relearning Scores and the Standard Deviations for the Overlearning and Difficulty Variables	33
6	Kruskal-Wallis Tests for the Effects of the two Variables Overlearning and Task Difficulty and the Interaction: Relearning Scores	34

CHAPTER I

INTRODUCTION

Effective learning depends a great deal upon the learner himself. Unfortunately this is one dimension over which physical educators have no direct control. Efforts, therefore, must be directed toward determining the external conditions which best promote learning. The ideas of mental and physical practice, massed and distributed practice, whole and part teaching methods, and others, have been explored in an attempt to determine the conditions most conducive to learning.

Obviously the time spent teaching skills would be wasted unless some learning (retention) was evident. Motor skills, on the whole, are found to be retained for a long time (swimming, bicycle riding). Usually the good retention of motor skills is largely attributed to the large amount of overlearning customarily associated with motor performance. In fact, many advocate that overlearning is necessary for retention (Oxendine 1968, Singer 1968, Lockhart 1967).

2.

Physical educators must consider overlearning since they must be concerned with not only the students' level of proficiency throughout the term but also with later performance (retention). Good retention will enable the individual to participate after leaving the educational setting. Therefore retention, and factors aiding its increase, are important topics for consideration by the practitioner.

Overlearning, which is widely accepted as playing a major role in retention, has not been satisfactorily explored. Most experimental data on overlearning and retention is derived from studies on verbal skills. Studies dealing directly with the problem of overlearning and retention of motor skills are scarce. The positive relationship between overlearning and retention found in verbal skills has been adopted by those in the field of physical education.

To be of curricular value many of the assumed relationships must be supported by scientific evidence.

Once the question of the usefulness of overlearning for retention of various types of motor skills is answered it should lead to more beneficial use of activity time.

Need for the study:

It is generally accepted that a factor which is most important in the retention of any type of skill is the degree of original learning; i.e. overlearning. Theoretically, according to Oxendine (1968), overlearning is not practiced for the purpose of improving performance but rather to "set", or reinforce learning so that better retention will result.

Overlearning is credited with the apparent better retention of motor skills in relationship to verbal skills, (Melnick 1971, Oxendine 1968, Garry 1963). Throughout motor learning textbooks the practice of overlearning has been advocated, (Stallings 1972, Singer 1968, Oxendine 1968). Assuredly, it plays a major role when considering a competitive level where movements

must become automatic, but is this the case in the school learning situation? The commonly accepted belief is expressed by Oxendine (1968);

Overlearning is usually a sound investment for teachers and students. Teachers must plan for overlearning. (p. 117)

The fact remains that motor skills are retained at a high level (Ryan 1965, Fleishman and Parker 1962, Purdy and Lockhart 1962, Ryan 1962, Jahnke 1958, Bell 1950). Not only do these studies find high retention but also quick relearning to the previous level of proficiency. These studies, however, do not consider the degree of overlearning involved.

The problem under investigation at the present time is the role, if any, that overlearning might play in the retention and relearning of motor skills. To what extent do these often observed phenomena depend on overlearning?

The findings from related studies, to date, do not allow the reader to draw any conclusions regarding the question under consideration. Those few studies dealing with the effect of overlearning on the retention of motor skills are divided in their findings. Recent studies (Melnick 1971, Hammerton 1963) question the necessity of overlearning, while Oxendine (1968), Singer (1968), and Krueger (1930) suggest its importance. The lack of conclusive evidence suggests a need for further investigation into this area.

The answer to the question of overlearning is important as a foundation, but if the findings are going to be applied to help the practitioner other factors inherent in motor skills must also be considered. The idea of task difficulty is basic to physical education and yet has rarely been considered in studies concerned with skill acquisition. There is a possibility that the amount of overlearning resulting in the best retention may differ with the difficulty of the task. It is a necessary question to answer if meaningful application is our goal.

Purpose of the study:

The present study has four purposes:

- 1) To determine what amount of overlearning, if any, is most beneficial for absolute retention of a motor skill.
- 2) To determine what amount of overlearning, if any, is most beneficial for decreasing the relearning time of a motor skill.
- 3) To determine if there is an interaction between the amount of overlearning and the difficulty of the task performed for absolute retention of a motor skill.
- 4) To determine if there is an interaction between the two variables overlearning and task difficulty for the relearning time of a motor skill.

Hypotheses:

1. There will be significant differences in the mean absolute retention scores of the overlearning groups.
2. There will be no significant differences found between the mean relearning scores on the overlearning variable.
3. There will be no significant interaction between the two variables overlearning and task difficulty on mean absolute retention scores.
4. There will be no significant interaction between the two variables overlearning and task difficulty on mean relearning scores.

Definition of terminology:

Absolute Retention Score:

The score obtained by each S on the first retention trial is considered the absolute retention score.

Difficult Task:

The difficult task involves only a total of five degrees, i.e. two and one-half degrees, on either side of the horizontal, in which range the S is counted in balance.

Easy Task:

This involves maintaining the balance board within a total range of ten degrees, i.e. five degrees on either side of the horizontal. When the board is kept within this range time in balance is being recorded.

Learned:

The tasks will be considered learned once a criterion of 22 seconds in balance, out of a possible 30 seconds, is met.

Overlearning:

The meaning suggested by Oxendine (1968) will be used for this study. "The term overlearning refers to the continued practice of a task after it has been learned". (p. 115) Practice involving efforts to improve or refine skills is not considered overlearning but rather new learning. The amount of overlearning will be expressed as a percentage in relationship to the number of trials initially required to reach criterion.

Relearning Score:

The number of retention trials necessary for the S to return to criterion level will be the relearning score.

Retention:

The persistence of proficiency on a skill following periods without practice. (Stallings p. 137) It indicates the stability of improvement and so is considered a good measure of learning (or forgetting).

Retention Interval:

That time from the last practice trial to the first retention trial. This is a period of no practice.

Limitations of the Study:

1. The overlearning for some subjects spanned a weekend and therefore two days of interpolated rest were unavoidable. Also some subjects experienced rest intervals within the initial learning experience itself, due to absence from school.
2. The degree of motivation throughout the testing sessions could not be rigidly controlled. However an effort was made to control some factors which may have influenced motivation. All subjects were given standard instructions as to the nature of the study and the operation of the stabilometre. Subjects were tested individually with no spectators present.

It was also made clear that scores could not be realistically compared with those of classmates since everyone was not tested at the same difficulty level.

3. The amount of physical activity prior to the testing periods could not be controlled.

CHAPTER II

REVIEW OF RELATED LITERATURE

The literature of interest to this investigation will be divided into the following areas: retention of motor skills, and overlearning of motor skills.

Retention of motor skills:

It is generally accepted that motor skills are better retained than verbal skills. The validity of this comparison has been questioned but the fact remains that motor skills are usually found to be highly retained and quickly relearned. This generalization of good retention has been supported by the retention studies completed.

Bell (1950) employed the pursuit rotor to investigate the retention of motor skills. This investigator found that over the one year retention period scores dropped 28 percent yet by the end of the eighth relearning trial the group had regained all that was forgotten.

Ryan (1962) followed the same line of inquiry but was also interested in the idea that perhaps retention differed among motor skills involving different components. To this end he employed the pursuit rotor and stabilometre. Again no difference was found between the various retention intervals on either task. Both motor skills were retained with little loss over extended periods of time. The trend was for performance in the stabilometre to be impaired but this loss disappeared very quickly. Ryan (1965) again considered retention of skill on the stabilometre and obtained results consistent with his earlier study. Skill on the stabilometre was highly resistant to forgetting and there was rapid relearning after retention intervals of up to a year.

The idea forwarded by many researchers in the area of retention is that the level of proficiency of the original learning is important in determining the amount retained. Some retention studies considered this aspect.

Jahnke (1958) investigated the effect that four levels of practice had on the retention of a motor skill. The data suggested that initial post rest performance was related to the amount of practice experienced. He concluded that retention after an interval of no practice increased with the amount of practice initially received.

Fleishman and Parker (1962) considered a highly complex continuous control task which required considerable practice for initial learning. They found that retention of the skill was very high even up to 24 months. By comparison with original learning of the skill there was little loss in performance over the retention interval and this was recovered in the first few minutes of practice. The most important factor determining retention, according to their results, seemed to be the level of original learning.

Purdy and Lockhart (1962) added further evidence. After studying the retention of five novel motor skills (one year interval), 94 percent of the original proficiency

was retained and relearning was rapid. Those who had originally learned more performed better which led to the conclusion that degree of original learning appeared to be of importance in retention. All skills were retained well and relearned so quickly that the question was raised that teachers may underestimate skill retention and spend too much time on basic review.

As had been indicated, most studies concerning the retention of motor skills find good retention and rapid relearning. One factor considered to be important is the degree of original learning. The current problem lies in quantifying the amount of learning which produces good retention and quick relearning. This has been the goal of those concerned with overlearning, as it applies to the area of motor skill acquisition.

Overlearning of motor skills:

It is a usual assumption that the higher the level of initial learning the more retention will occur.

However, with respect to verbal skills, this has not been found to be the case. It appears that retention of verbal skills is in fact enhanced by overlearning but there is some evidence of a phenomenon of diminishing returns. That is, there appears to be a point beyond which it is not economical to continue practicing. The question of interest in this paper is the effects of overlearning on motor skills. Are motor skills affected in the same manner as verbal skills; is it beneficial to a certain point and then becomes impractical?

One of the first to consider this question was Krueger (1930). He investigated the effects of overlearning on a maze tracking task in a series of two studies. The first study completed included 0,50 and 100 percent overlearning groups. As the degree of overlearning increased from 0 to 50 percent there was an increase in all retention scores for all intervals (1, 2, 3, 4, 7, 14 days). The retention test involved relearning the task to criterion. This follows the popular belief that overlearning is of benefit for better retention. However, as

the degree of overlearning increased from 50 to 100 percent the increase in retention scores was found to be proportionally more economical than the 0 to 50 percent increase. Since this was unexpected he repeated the study with a group receiving 200 percent overlearning. The results showed that, although the scores were always higher for the 200 percent overlearning group, the differences were not always appreciable. The increase was not as economical as that from 50 to 100 percent.

Subsequent studies by Rubin-Rabson (1941) and Melnick (1971) showed similar findings. Melnick (1971) noticed this phenomenon of diminishing returns in his consideration of immediate recall. He found that overlearning facilitated immediate recall but 50 percent was as effective as 100 or 200 percent.

Rubin-Rabson (1941) was concerned primarily with this concept of diminishing returns and not with the effectiveness of overlearning per se. She found that the small savings in time required to relearn the skill (keyboard playing) did not justify the large investment of learning trials. She felt that,

There is ample evidence that 100% and 200% overlearning are no more effective for retention than 50% overlearning. (p. 693)

Therefore, there are authors who advocate the necessity of overlearning for improving retention and most agree that 50 percent is the most economical amount.

However not all findings in this area are consistent. Not all agree that,

...50% overlearning is advantageous, but practice beyond that does not afford a proportional gain for the extended effort. (Singer, 1968, p. 167)

Melnick (1971) and Hammerton (1963) have forwarded the premise that overlearning has no significant effect on the retention of and time to relearn a motor skill. It was previously noted that Melnick (1971) did find significant differences on absolute recall scores; score on the first retention trial. However different results were obtained when relative retention scores were considered (average of

trial three and four). After a one month retention interval the only significant difference was found in the 200 to 0 percent comparison (in favour of 200 percent). All groups regardless of amount of overlearning relearned the skill very quickly.

Hammerton (1963) found essentially the same thing. He noted that overlearning improved initial recall but the overlearning and control groups both forgot a significant amount (after 26 weeks) and for both groups recovery was rapid. In fact, Hammerton concluded that in practical situations overlearning of difficult tasks is to be recommended if initial recall is important but it is not crucial when there is time for review.

Melnick et al. (1972) investigated overlearning from a different perspective. The purpose was to see if using a percentage, based on each individual's performance, to determine the amount of overlearning discriminated

against fast learners. All subjects received 100 percent overlearning on the stabilometre and were retested one week later. It was concluded that those who took a relatively small number of trials to reach criterion were not at a disadvantage when compared to those who took a larger number of trials to reach the same criterion.

There have been few research studies attempted in the area of overlearning of motor skills. However the results do appear to substantiate the concept of diminishing returns and 50 percent seems to be the most beneficial amount. It is apparent that overlearning does have some effect on initial recall but the suggested rapid relearning leads to the questioning of its necessity in practical situations.

CHAPTER III

RESEARCH METHODS

The purposes of this study are to determine: 1) what amount of overlearning, if any, is most beneficial for absolute retention of a gross motor skill, 2) what amount of overlearning, if any, is most beneficial for decreasing the relearning time of a gross motor skill, 3) if an overlearning X task difficulty interaction exists for the mean absolute retention scores, and 4) if an overlearning X task difficulty interaction exists for the relearning scores.

The subjects

The sample of 72 elementary school children was drawn from two schools in the Blackburn Hamlet area; Blackburn Hamlet Catholic School and Emily Carr Middle School. Blackburn Hamlet is a residential area located close to Ottawa, Ontario. The subjects ranged in age from 11 to 13 years (grades six, seven, and eight). Stratified sampling was employed using grade and school as strata (Fox, 1969). No subject was familiar with the task.

All subjects completed the learning session but one subject was not available for the retention session. Since an unbalanced design was not acceptable for the analysis to be used (Kruskal-Wallis) one subject was randomly deleted from each of the other groups leaving a total of 66 subjects.

An effort was made to eliminate extreme scores by using only those subjects whose learning rate fell within the limits found to be usual. These points were chosen as a result of findings in a pilot study (Yeates, 1973). Only those subjects reaching criterion in not less than two and not more than 20 trials for the easy task, or between four and 40 trials on the difficult task were used.

Experimental design:

As can be seen in table 1, the subjects were divided into six groups. The practice schedule for all groups was the same until criterion was reached. At this

time the appropriate number of overlearning trials was administered. A seven week interval of no practice was observed and then the retention trials began. During the retention session the format was identical to the learning sessions to the point of criterion being attained. Once criterion had been reattained the retention session was terminated.

TABLE 1 - EXPERIMENTAL DESIGN

		OVERLEARNING			7 WEEKS	
		0%	50%	100%	No Practice	Retention Test
TASK	EASY	r = 11				
	DIFFICULT					

The stabilometre:

The stabilometre used was similar to the apparatus used by Melnick (1971). It was produced by the Marietta Apparatus Company (Model 3-15A). Basically it was comprised of a rod suspending the deckplate (balance board), and a base platform. The rod was 20 inches long and was situated 20 inches above the floor. The deckplate was 36 inches long and 18 inches wide and had a vertical displacement of 3 inches. A digital .001 second timer provided a readout of the time during which the board was within the balance range (i.e. time in balance). The recycling timer and digital readout was in a separate unit which was connected to the platform. The micro-switches, which started and stopped the timer, were adjustable to establish the desired angle within a range of zero to five degrees of arc on each side of the centre balanced position.

Procedures :

Prior to the commencement of testing the experimenter spoke to the subjects as a group. At this time the task was briefly explained and a reason given for doing the study. It was made clear that scores could not be meaningfully compared with those of classmates since the difficulty level would not be the same for everyone.

The subjects were instructed individually as they came to be tested. Each subject was given standard verbal instructions which were accompanied by a practical demonstration (see Appendix A). The subject stood with his feet straddling the pivot bar and facing the digital timer. At the start of each trial one side of the platform was resting on the stand and therefore was out of balance. On the signal "ready-go" a stop watch and the digital timer were started and the subject attempted to gain and maintain a balanced position. The subject continued trying to balance throughout a 30 second interval at the end of which the experimenter said "stop". The timer was stopped so that the time in balance was visible, the time was

verbally reported to the subject and then recorded by the experimenter. The timer was then reset and the next trial started once the rest interval was completed. Thus one trial consisted of 30 seconds of work followed by 30 seconds of rest.

The overlearning trials were initiated as soon as criterion was reached. The criterion to be attained was 22 seconds in balance out of a possible 30 seconds. This criterion was chosen as a result of findings in a pilot study (Yeates, 1973).

To determine the number of overlearning trials, percentages of the number of trials initially required to reach criterion were used. If a subject required ten trials to reach criterion then an additional five trials represented 50 percent overlearning and an additional ten trials represented 100 percent overlearning. If the number of trials to reach criterion was odd then half of the next higher number was used as the number of trials at the 50 percent level. If seven trials were required then four additional trials constituted 50 percent overlearning.

Seven weeks after the last trial each subject was tested. At this time the task was explained once more and the subject was asked to try and balance for 22 seconds. The same format as in the learning session was followed until the criterion was reached. Once criterion was attained the subject was finished. Therefore, throughout both the initial learning and the retention testing a trial consisted of 30 seconds on the stabilometre followed by 30 seconds rest. A maximum of ten trials per day were given to avoid fatigue.

Treatment of the data:

a) Hypotheses one and three:

Both of the overlearning groups will do better than the no overlearning group on mean absolute retention scores. There will be no interaction between the overlearning and task difficulty variables on mean absolute retention scores. A two factor analysis of variance (Keith, 1972) was calculated to test for significance on the absolute retention scores.

The Tukey post hoc test was used when significance was noted (Keith, 1972).

b) Hypotheses two and four:

There will be no differences on the overlearning variable for the mean relearning scores. There will be no significant interaction between overlearning and task difficulty.

The Kruskal-Wallis test was used to analyze the relearning scores. Due to the nature of the Kruskal-Wallis, which is associated with one factor designs, three H statistics were calculated, one for each of the variables and one for the interaction (Keith and Cooper, 1973). To be used with a multi-factor design all the factors except the one being considered were combined resulting in a one factor model. The scores from this collapsed design were then ranked and these ranks used to produce the Kruskal-Wallis H statistic.

The correction for tied ranks was used when necessary.

CHAPTER IV

RESULTS

The results concerning the four hypotheses under investigation will be presented in this chapter.

Hypotheses one and three:

- 1) The mean absolute retention scores for the overlearning groups will be greater than the score for the zero percent group.

- 3) There will be no interaction between the variables overlearning and task difficulty for the mean absolute retention scores.

The mean values for absolute retention for each of the groups, and the corresponding standard deviations are presented in table 2. Of interest is the apparent trend of increasing scores as the amount of overlearning received increases.

TABLE 2 - MEAN ABSOLUTE RETENTION SCORES AND STANDARD DEVIATIONS FOR EACH OVERLEARNING GROUP AND BOTH DIFFICULTY LEVELS

TASK	OVERLEARNING					
	0%		50%		100%	
	M*	SD**	M	SD	M	SD
Easy	20.94	2.26	23.18	1.44	22.62	3.04
Difficult	17.71	3.32	19.50	3.17	20.36	3.86

* M = mean

** SD = standard deviation

Table 3 presents the results of a two factor analysis of variance (Keith, 1972) for the variables overlearning and task difficulty. Significance was noted for the variables of overlearning and task difficulty but not for the interaction.

TABLE 3 - TWO FACTOR ANALYSIS OF VARIANCE FOR THE VARIABLES OVERLEARNING AND TASK DIFFICULTY: ABSOLUTE RETENTION SCORES

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F RATIO
Overlearning	2	64.26	32.13	3.33 *
Task	1	154.50	154.50	16.01 *
Interaction	2	5.81	2.90	0.30
Error	60	578.95	9.64	

* significant at 0.05 level F = 3.15 with 2,60df
F = 4.00 with 1,60df

Post hoc procedures were necessary to determine where the significant differences existed in the overlearning variable. Table 4 shows the simultaneous confidence intervals for all the possible contrasts as obtained by the Tukey test. In this table the reader may observe that the 50 and 100 percent overlearning groups' scores were significantly different from the zero percent group. This significance was in favour of the overlearning groups; that is, the 50 and 100 percent groups were both better than the

zero percent group. The 50-100 percent comparison did not reach significance.

TABLE 4 - SIMULTANEOUS CONFIDENCE INTERVALS FROM THE TUKEY TEST FOR ALL POSSIBLE COMPARISONS BETWEEN OVERLEARNING LEVELS: ABSOLUTE RETENTION SCORES

<u>CONTRAST</u>	<u>LIMITS OF CONFIDENCE INTERVAL</u>	
	UPPER	LOWER
50% - 0%	2.84	1.19 *
50% - 100%	0.97	-0.67
100% - 0%	2.98	1.33 *

* significant at 0.01 level

Hypotheses two and four:

- 2) There will be no difference in the mean relearning scores for the overlearning variable.

- 4) There will be no interaction between the variables overlearning and task difficulty for the mean relearning scores.

The mean values for the number of trials to relearn the task and the corresponding standard deviations are reported in table 5. The cell means for all levels of overlearning and task difficulty are presented for each group.

TABLE 5 - MEAN VALUES FOR RELEARNING SCORES AND THE STANDARD DEVIATIONS FOR THE OVERLEARNING AND DIFFICULTY VARIABLES

TASK	AMOUNT OF OVERLEARNING					
	0%		50%		100%	
	M*	SD**	M	SD	M	SD
Easy	3.28	2.57	1.90	1.81	1.63	1.20
Difficult	5.00	4.38	3.09	2.34	2.72	3.40

* M = mean

** SD = standard deviation

Table 6 shows the results obtained from the three one-factor Kruskal-Wallis tests. No significance was noted for any of the three factors of overlearning, task difficulty or the interaction.

TABLE 6 - KRUSKAL-WALLIS TESTS FOR THE EFFECTS OF THE TWO VARIABLES OVERLEARNING AND TASK DIFFICULTY AND THE INTERACTION: RELEARNING SCORES

SOURCE OF VARIANCE	DEGREES OF FREEDOM	H *
Overlearning	2	4.35
Task	1	2.73
Interaction	2	1.02

* The chi squared values required for significance at the 0.05 level were 5.991 df 2, 3.841 df 1

CHAPTER V

DISCUSSION OF THE RESULTS

Those groups receiving 50 and 100 percent overlearning both scored significantly higher than the zero percent overlearning group. This is in accord with the results noted by Melnick (1971) and Hammerton (1963), who both found that overlearning enhanced initial recall.

These findings also lend support to the concept of diminishing returns. In this study the 100 percent group did not perform significantly better than the 50 percent group. This concurs with the conclusions of many authors who report that it is not economical to exceed 50 percent overlearning (Melnick 1971, Singer 1968, Rubin-Rabson 1941).

No significant interaction between overlearning and task difficulty existed. This indicates that the most beneficial amount of overlearning does not vary with the difficulty of the task. It seems that task difficulty is not an important consideration when deciding the degree of overlearning to be used.

From the data presented it appears that overlearning is an important variable resulting in better initial recall. However, within the limits of the degrees of overlearning chosen, 50 percent seems to be the most economical amount.

In the present study no significant differences were found when relearning scores were considered. This agrees with Melnick's (1971) data. Using the 'saving method' to compute the relative retention score, Melnick found no significant differences for the variable of overlearning. These findings substantiate what Hammerton (1963) briefly mentioned; that is, recovery of proficiency was very rapid regardless of the amount of overlearning. This evidence is similar to that reported in the retention studies (Ryan 1965, Purdy and Lockhart 1962, Fleishman and Parker 1962, Ryan 1962). Such studies invariably mentioned the fast relearning, or rapid regaining of former proficiency.

Krueger (1930) reported results which differ from the present findings, in that he found an increase in retention from zero to 50 percent and from 50 to 100 percent overlearning. The different results may have been influenced by the method of measurement used. The retention test involved relearning the task to the initial criterion. From this he obtained three retention scores 1) the number of trials necessary for relearning (used in the 'saving method'), 2) the time required for relearning, and 3) the number of errors made during relearning. The saving method considered the ratio of the trials required for initial learning to the number of relearning trials expressed as a percentage. The other scores used by Krueger (1930) were the difference between the respective initial and relearning score.

Krueger's results however, must be viewed with reservation since the statistical analysis used to obtain them is not stated. Any such analysis appears to have been of a gross nature since most references made to differences are in the form of 'consistent differences'. Differences were apparent but any significance cannot be determined with certainty.

Krueger (1930) reported the mean values for the number of trials to relearn the task. It is apparent from these values that very slight differences in the time to relearn the task existed among the groups. When comparing the 100 percent to the zero percent group, the difference in mean number of trials ranged from 1.34 to 0.16 for the different retention intervals.

The task used could also be a partial explanation for the different findings reported by Krueger (1930). The tracing of a maze with one's finger is high on the cognitive end of the motor skills continuum. Since it has a large verbal component perhaps some characteristics applicable to verbal skills would be evident. It is generally accepted that overlearning is of benefit in the retention of verbal skills (Singer 1968, Krueger 1929).

Once again when the overlearning X task difficulty interaction was considered no significance was noted. As with the absolute retention the most beneficial amount of overlearning appears to depend little on the difficulty of the task.

The findings concerning overlearning and retention indicate that, for initial recall, overlearning groups retain a significantly greater amount than the group with no overlearning. This may be of interest to those involved in situations where initial recall is of importance. However a more important aspect within the educational setting is relearning time and it is when these means are compared that no significant differences are found. These findings indicate that time used in overlearning a skill could be more profitably used in activity other than extra practice.

The reader must be aware of the hazards of overgeneralization from this study to the practical situation involving all motor tasks. The task used was not of a practical nature. Two levels of difficulty were used which indicates an attempt at providing a more realistic situation but the task involved only the basic motor abilities of balance and coordination.

In addition to the task being laboratory in nature the idea of time spent in learning the task should be considered. Although no significant differences were found on the relearning scores a trend does exist. If the reader views the mean values to relearn the task (table 5) it can be seen that the time decreases as the amount of overlearning increases. There is a possibility that, if the task had required more time to be spent on reaching criterion, this trend would have produced larger differences.

Due to these reasons the results of the present study cannot be directly applied to practical situations. The fact that the findings are in opposition to a currently popular belief, that is, overlearning is necessary for good retention, suggests that further research in this area must be conducted. Future studies should try to utilize more practical tasks in a realistic situation as much as possible in order that more direct inference can be made.

Although the data involving the variable of task difficulty is not of primary concern in this study, it will be discussed briefly for its interest value to the reader. The significance found for this variable on the absolute retention was not only expected, but in fact inherent in the study itself due to the choice of the two difficulty levels. Those balancing at the easy level had a much larger "in-balance" range and consequently would be expected to score better on the initial retention trial.

The fact that no significance was noted for the relearning score would be expected. Once having learned the difficult task it would not take significantly longer to regain proficiency than one who had learned an easier task to regain proficiency at that level. The initial disadvantage due to smaller error allowance disappeared with practice.

The results for task difficulty follow the same pattern as those for the degree of overlearning; that is, significant differences are found when considering absolute retention and no significance evident when relearning is considered.

Finally, there are a number of points for future consideration. It is possible that researchers are looking at overlearning from the wrong perspective. As it was defined for this study overlearning consisted of extra practice alone, with no consideration of the quality of that practice. It may be possible, as Stallings (1973) states, that the value of more trials per se is questionable. If the extra trials are attempted and no attention directed toward the subject's attitude there is a possibility that the practice would result in boredom. Execution for the sole purpose of terminating the practice period is of doubtful benefit in learning a skill. Some motivational technique, such as being directed towards a new goal, could be employed to help ensure profitable practice.

Hammerton (1963) was concerned with the quality of the extra practice and so required a specified improvement before the task was considered overlearned. This specific method would not be practical in a curricular situation due to the unknown time which would be required to reach the new criterion. However, all subjects could be encouraged to try for a new goal within their overlearning sessions.

The criterion to be met for initial learning in Hammerton's study seemed to be quite high which, in all probability, made the task difficult. In Melnick (1971) it was mentioned that criterion was very close to the maximum possible score which may have produced a ceiling effect and masked any significance. Observations such as these lead to the realization that criterion values are of great importance. One is usually estimating, from previous experience, the point at which the task is learned. It could be that too low a criterion on any task does not allow enough learning to take place and, conversely, a high criterion will not allow large enough differences to exist. Possibly changing the idea of criterion from a single attainment of an established goal to one of a more exacting nature would help one to be more certain that the task had been learned. The most exacting method of determining the "learned" point would be through an examination of muscle activity. The use of electromyography would allow a close scrutiny of muscle patterns to be kept and once the pattern became stable, with proper execution of the skill, the task would be considered learned.

The benefit of overlearning varies with the various applications. It is an important concept used widely by coaches who are concerned with the superior athlete. At this level actions must be automatic and not under the control of conscious thought. This can only be achieved by repetitive practice. The value of overlearning in a physical education curricular setting is questionable. As research evidence has indicated, overlearning is beneficial in aiding initial recall but not in significantly decreasing the relearning time. Such studies employed laboratory tasks so the need now is to try and test the usefulness of overlearning in the curricular setting. Only in this manner could the real benefits of overlearning be examined.

CHAPTER VI
SUMMARY AND CONCLUSIONS

Summary

Purpose and Hypotheses

The purpose of this study was to investigate the effects of different amounts of overlearning and task difficulty on the retention and relearning of a gross motor task. Four hypotheses were proposed: 1) the mean absolute retention scores for the 50 and 100 percent overlearning groups would be higher than the zero percent group, 2) there would be no significant differences for mean relearning scores on the variable overlearning, 3) there would be no significant interaction between overlearning and task difficulty on absolute retention, and 4) the overlearning X task difficulty interaction would not be significant for relearning scores.

Procedures

Two schools selected from the Blackburn Hamlet area. The total sample (N = 72) included grades six, seven, and eight. The subjects practiced balancing on the stabilometre until the criterion was reached. The

appropriate number of overlearning trials were then administered and a seven week retention interval observed. In the retention testing all subjects practiced balancing until criterion was reattained. A two-factor analysis of variance and a series of Kruskal-Wallis tests were employed to determine if significant differences existed on initial recall and relearning scores.

Results

1. Statistically significant differences, on absolute retention, were noted in favour of the 50 and 100 percent overlearning groups.
2. The overlearning X task difficulty interaction was not significant for the absolute retention scores.
3. No significance was noted for the relearning scores on the variable overlearning nor for the overlearning X task difficulty interaction.

Conclusions

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

1. The mean absolute retention of the gross motor task was significantly better for those groups with overlearning, but 50 percent was as effective as 100 percent.
2. Mean relearning time was not significantly affected by overlearning. The zero percent group relearned to criterion as quickly as those with overlearning.
3. The amount of overlearning which provided the most benefit, in terms of absolute retention, did not differ with task difficulty.
4. The amount of overlearning which was most profitable in decreasing relearning time did not differ with the difficulty of the task.

REFERENCES CITED

REFERENCES CITED

- BELL, H.M. "Retention of Pursuit Rotor Skill After One Year", J. Exp. Psych., 40: 648-649, 1950.
- FLEISHMAN, E.A. and PARKER, J.F. "Factors in the Retention and Relearning of Perceptual Motor Skill", J. Exp. Psych., 66: 6-11, 1962.
- FOX, D.J. "The Research Process in Education", New York: Holt, Rinehart and Winston, Inc., 1969.
- GARRY, "Psychology of Learning", Washington: Cen. appl. Res. Educ., 1963.
- HAMMERTON, H. "Retention of Learning on a Difficult Tracking Task", J. Exp. Psych., 66: 108-110, 1963.
- JAHNKE, J.C. "Retention in Motor Learning as a Function of Amount of Practice and Rest", J. Exp. Psych., 55 (3): 270-273, 1958.
- KEITH, V. "Design and Analysis in Experimentation", Ottawa: University of Ottawa Press, 1972.
- KEITH, V. and COOPER, M. "Non-Parametric Design and Analysis for the Behavioural Scientist", Ottawa: Faculty of Education, 1973.
- KRUEGER, Wm. "The Effect of overlearning on Retention", J. Exp. Psych., 12: 71-78, 1929.

- KRUEGER, Wm. "Further Studies in Overlearning", J. Exp. Psych., 13: 152-163, 1930.
- LOCKHART, A. "Conditions of Effective Motor Learning", JOHPER, 38 (2): 36-39, 1967.
- MELNICK, M.J. "Effects of Overlearning on the Retention of a Gross Motor Skill", RQ, 42 (1): 60-69, 1971.
- MELNICK, M.J., LERSTEN, K.C., and LOCKHART, A.S. "Retention of Fast and Slow Learners Following Overlearning of a Gross Motor Skill", J. Motor Behav, 4 (3): 187-193, 1972.
- OXENDINE, J.B. "Psychology of Motor Learning", New York: Appleton-Century-Crofts, 1968.
- PURDY, B.J. and LOCKHART, A.S. "Retention and Relearning of Gross Motor Skills after Long Periods of no Practice", RQ, 33: 265-272, 1962.
- RUBIN-RABSON, G. "Studies in the Psychology of Memorizing Piano Music VII A Comparison of three Degrees of Overlearning", J. Ed. Psych., 32: 688-695, 1941.
- RYAN, E.D. "Retention of Stabilometre and Pursuit Rotor Skills", RQ, 33: 593-598, 1962.
- RYAN, E.D. "Retention of Stabilometre Performance Over Extended Periods of Time", RQ, 36: 46-51, 1965.

- SINGER, R.N. "Motor Learning and Human Performance",
New York: MacMillan, 1968.
- STALLINGS, L.M. "Motor Skills - development and learning",
United States: Wm. C. Brown Company
Publishers, 1973.
- YEATES, M. "The Effect of Overlearning and Task Difficulty
on the Retention of a Motor Skill",
(unpublished paper, University of Ottawa,
1973).

APPENDIX A

STANDARD INSTRUCTIONS FOR THE SUBJECTS

STANDARD INSTRUCTIONS FOR THE SUBJECTS

This is a stabilometre. It moves something like a teeter-totter (E shows how balance board moves). I want you to stand on it like this and position your feet wherever they are most comfortable. (E mounts stabilometre to demonstrate the remaining instructions). Try to keep the board in balance as long as you can. If this clock (E points) is running the board is in balance and if the clock stops it is out of balance. If the clock is running and you don't move the board it will keep on going, like this.

Start with one side of the board touching the base. When I say "go" try to get into balance and continue balancing until I say "stop". The goal I'd like you to reach is 22 seconds. That means 22 should show on the clock. Any questions?

APPENDIX B

RAW DATA

ABSOLUTE RETENTION SCORES FOR ALL SUBJECTS

EASY	S*	0%	50%	100%
	1	19.94	24.00	24.89
	2	21.10	20.54	26.76
	3	20.28	23.37	20.10
	4	22.88	25.80	22.27
	5	24.09	23.42	26.72
	6	17.89	24.79	18.17
	7	22.69	20.89	21.17
	8	17.79	22.81	17.59
	9	22.56	23.00	23.21
	10	23.42	23.66	22.39
	11	17.73	22.75	25.57
DIFFICULT				
	1	12.14	22.67	13.47
	2	17.78	21.37	25.32
	3	20.87	16.75	22.47
	4	25.49	17.00	23.31
	5	17.02	20.50	16.84
	6	15.59	14.53	20.44
	7	14.04	18.54	23.01

* Subjects

S*	0%	50%	100%
8	18.50	22.01	24.54
9	18.44	19.67	17.77
10	16.89	25.61	22.13
11	18.06	15.84	14.65

* Subjects

NUMBER OF TRIALS REQUIRED TO REACH CRITERION (I)
AND TO RELEARN TO CRITERION (R)

EASY	S*	0		50		100	
		I	R	I	R	I	R
	1	4	2	3	1	3	1
	2	4	2	9	7	8	1
	3	4	5	15	1	3	2
	4	3	1	6	1	10	1
	5	8	1	5	1	6	1
	6	6	8	4	1	16	2
	7	3	1	6	3	12	2
	8	8	7	7	1	8	5
	9	3	1	3	1	7	1
	10	8	5	3	1	10	1
	11	8	1	12	1	7	1
DIFFICULT							
	1	23	8	15	1	20	12
	2	5	3	20	2	29	1
	3	35	2	19	4	33	1

* Subjects

ABSTRACT

THE EFFECTS OF OVERLEARNING AND TASK DIFFICULTY ON THE RETENTION AND RELEARNING OF A GROSS MOTOR TASK

By

Marilyn Edith Yeates

The purpose of this study was to investigate the effects of different amounts of overlearning on the retention of a gross motor skill.

Four hypotheses were proposed: 1) the mean absolute retention scores of the 50 and 100 percent overlearning groups would be greater than the score for the zero percent group, 2) there would be no significant differences found between the mean relearning scores on the overlearning variable, 3) there would be no significant interaction between the two variables overlearning and task difficulty on mean absolute retention scores, and 4) there would be no overlearning \times task difficulty interaction on mean relearning scores.

Two schools from Blackburn Hamlet, in the Ottawa-Carleton region, were selected. Seventy-two students* from grades 6, 7 and 8 were used as subjects.

The subjects were divided into six groups by stratified sampling using school and grade as strata. This involved a 3 x 2 design with three levels of overlearning and two levels of task difficulty. All subjects learned to balance to criterion on the stabilometre, received the appropriate amount of overlearning and then observed a seven week interval of no practice.

During the retention session each subject continued to balance until criterion was re-attained. This resulted in two scores for each subject; the absolute retention score and the relearning score.

A two-factor analysis of variance was employed to determine if significant differences existed on the

* Total N = 66 after deletion due to insufficient data

overlearning variable for absolute retention. Three one-factor Kruskal-Wallis tests were calculated using the relearning scores to determine if any significant differences existed.

The results showed that for initial recall 50 and 100 percent groups performed significantly better than the zero percent group. However no significance was noted between groups with respect to relearning scores. Neither of the interactions involving percentage of overlearning and task difficulty was significant.