

THE EFFECT OF COVERT AND OVERT PRACTICE
ON THE
ACQUISITION OF TYPEWRITING SKILLS

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Abstract

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This study evaluated the use of mixed covert and overt practice in the learning of typewriting skills.

Covert practice is defined as symbolic rehearsal of a task rather than an overt or actual practice. 36 female CEGEP subjects (aged 17 through 21) completed the study, 12 in the experimental group and 24 in the control group.

Subjects were given pretests and posttests which were evaluated for both speed and accuracy. The t-tests indicated a statistically significant improvement in both speed ($P < .05$) and accuracy ($P < .10$) after four one-hour sessions of mixed covert and overt practice. Findings were consistent within a pilot and a main study and compared favourably with other studies. Covert practice appears to be helpful in increasing speed and accuracy and students have a neutral or positive attitude toward the treatment.

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CHAPTER I

PROBLEM

1. Problem Formulation

Although improvement in any motor skill depends a great deal on continued physical practice, a vital part of the planning and performance of a motor action is the function of the brain. Covert practice is a valuable aid to the learning and performance of motor tasks as in such vocational skills as typewriting (Ulich, 1967) and in sports, for instance, basketball (Richardson, 1967a). It appears also that if covert and overt activity are used in the same practice period, a skill can be learned more quickly and with a better understanding of the performance technique (Stebbins, 1968). The term covert practice is used in this paper to mean mental rehearsal with no evidence of overt, active practice, or in other words, training through repeated imagination of the action to be learned.

In a survey of the literature it was found that a great many studies refer to symbolic or covert rehearsal of a task as "mental practice."

Since the classical implication of the word "mental" carries with it the notion of a "nonphysical" phenomenon, perhaps the term "mental practice" is unfortunate. The activity of the nervous system during mental practice is certainly "physical" in the sense that body cells are functioning and electric current is being passed along these nerve cells (Sage, 1971, p.328).

Other terms which have been used to signify the introspective or covert rehearsal that takes place within the individual are conceptualization, ideational functioning, and imaginary and implicit practice. In this study the term "covert practice" will be used to describe the rehearsal process and "overt practice" will refer to actual physical practice, except, of course, when other sources using different terminology are directly quoted. An example of how covert practice can be induced in students is given in Appendix D.

The majority of the studies on covert practice have involved the learning of athletic skills or simple motor tasks such as card sorting and ring tossing. Very little work has been done in the area of classroom learning. Covert practice, however, does have practical implications for classroom learning, especially for subjects in which motor skills are involved. Oxendine (1968) states the need for study of covert practice.

The role of conceptualization in motor skills has not been widely investigated by general psychologists. Apparently, this is because the concept of applying

mental rehearsal to the performance of motor tasks is not characteristic of the type of learning in which they are most interested, i.e. verbal learning. This lack of general application to problems in classroom learning has apparently resulted in the failure to rank mental rehearsal among the major issues in learning (Oxendine, 1968, p.223).

West, (1969) writing on the acquisition of typewriting skills, states that the implications of covert practice for typewriting instruction are obvious. One such study, using covert practice for typewriting instruction, was reported by Ulich (1967). This study is referred to in the next section and is more fully described in Chapter II.

2. Statement of Problem

The purpose of this study was to compare the effects of a combination of covert and overt practice with overt practice only in the learning of typewriting skills in a classroom situation, elaborating on the Ulich (1967) study. The procedure of covert practice used in this study of typing may be generalizable to all areas of motor training.

The report of the Ulich study indicated that a combination of covert and overt practice was an effective means of improving typewriting skills. In order to test the stability of the results, under different control conditions, a replication of Ulich's study was undertaken.

Ulich used fifteen minute periods for both covert and overt practice. In the present study, five minute alternating periods were used.

In the Ulich study the two typing variables, speed and accuracy, were measured as one unit; i.e., the errors were subtracted from the speed in order to ascertain the test results. In the study described in this paper, speed and accuracy were considered separately.

Therefore, in summary, the three basic problems in this study were: (a) to test the stability of the results of Ulich's study; (b) to establish if the five minute alternating periods of covert and overt practice were effective; and (c) to measure the effectiveness of covert and overt practice separately on both speed and accuracy.

Typing teachers, interviewed before this study was carried out, were enthusiastic about the potential use of covert practice as a teaching aid for typing. They willingly consented to the study being conducted, using their students, during regular classroom periods. There thus appears to be a theoretical and practical need for a study of covert practice in the teaching of typewriting.

The present chapter has described the problem of covert practice which has been chosen for the present study.

Chapter II includes a survey of the literature pertinent to this study, and a description of the pilot study. In the pilot study, using subjects drawn from fourth semester CEGEP classes, an experimental group was given a combination of covert and overt practice in typewriting, and the control group had overt practice only. Pretests and posttests were given to both groups and the results were compared. After the study questionnaires were given to the students in the experimental group in order to ascertain their general attitude toward covert study.

The design and conduct of a larger study are described in Chapter III. The main study, except for a few minor changes, followed the same pattern as the pilot study.

Chapter IV contains the results, a discussion of the study and recommendations for future studies.

CHAPTER II

THE LITERATURE REVIEW AND PILOT STUDY

1. Review of the Literature

The majority of the studies done on covert practice have involved novel motor tasks or common sports skills such as card sorting, mirror drawing, ring-tossing, juggling, basket ball free throw, tennis forehand and backhand drives, etc. (Richardson, 1967a, 1967b). A few studies have been done on improving muscular endurance (Kelsey, 1961) and increasing muscular strength (Razor, 1966).

In 1931, G.L. Freeman showed that covert practice is frequently accompanied by implicit muscular activity.

Jacobson (1932, 1934) showed in several electrophysiological studies that when subjects imagined their performance of a particular motor response they reacted by subconsciously flexing muscles which were used in overt performance of the task. In addition to the slight response in the muscle groups used in physical performance, action was also noted in such areas as the eyelids, tongue and lips.

In a somewhat similar study, Shaw (1938) found weight lifters exhibited muscular action when they imagined themselves lifting weights and that the greater the vividness in imagination, the greater the resulting muscular action.

Several studies have shown that covert practice contributes to motor skill learning. In an extensive review of covert practice studies, Richardson (1967a, p.95), reports that "An examination of the literature over the past 30 years shows that at least 25 studies have been concerned with the effectiveness of the procedure."

In general, the experimental design of the earlier studies was to have an overt practice group, a covert practice group and a control group. The trend in this type of study is for the overt practice groups to show the greatest gains, but the covert practice groups also show significant gains over the control groups. More recently, various combinations of mixed overt and covert practice have been evaluated.

In 1952, Harby used film to demonstrate the basketball free throw during the period of covert practice. The group that made the greatest gains in learning were instructed to think about the task or covertly practice for fourteen

class periods and then overtly practice it for seven additional periods. It is difficult, however, to draw any conclusions because of the small number of subjects in this group (N = 8) (Travers, 1964, p.2.95).

Stebbins (1968, p.720) found that "in learning a simple hand-eye coordination skill [throwing rubber balls at a target] the greatest amount of improvement is made by using a combination of [covert and overt] practice conditions."

There are benefits other than the purely empirical ones which are derived from mixed covert and overt practice. "Presumably positive transfer occurs from this art of conceptualization to overt performance (Singer, 1972, p.332):" Oxendine (1969) points out that getting students into the habit of thinking about or analyzing skills in an intellectual, kinesthetic and mechanical way is a desirable result of the use of covert practice.

"Another important reason why attention should be devoted to mental practice is that more efficient use might be made of the crowded facilities and limited equipment which prevail in many schools to-day (Oxendine, 1968, p.223)."

Thus the efficiency of covert practice has important implications for a cost-benefits analysis of educational technology.

West points out that the implications for typewriting instruction are obvious. He suggests that in very early keyboard learning, as homework, the students might be asked to covertly type some simple sentences, i.e., imagine they are typing the sentences they are reading. He adds that this tactic also applies, in class, to any situation in which, for one reason or another the student has no typewriter.

A variation in external stimulation often promotes attention on the part of the learner. Covert practice provides a stimulus novelty. West (1969, p.395) points out that "Boredom is a real risk in courses as lengthy as typewriting Varying the activities is a sound antidote or preventive for the loss of motivation resulting from boredom."

Oxendine (1969), in a study of different combinations of covert and overt practice, concluded that when a motor task is within the capacity level of the learner, up to 50% of the practice time (or trials) in covert practice can be as effective as 100% of the overt practice and that the proportion of the time which might be profitably devoted to covert practice appears to be dependent upon the nature of the task, i.e., its complexity, familiarity, and whether the learner has the physical abilities to perform the activity.

Using three skilled pianists in each of three groups,

Rubin-Rabson (1941) found that intensive covert rehearsal saved keyboard trials and was as effective for retention as a greater number of overt keyboard trials.

The only study reported on typewriting was conducted by Ulich (1967). The sample consisted of male and female students, aged 14 to 16, who had learned to typewrite in the first year.

On the basis of preliminary trials the subjects were divided into five matched groups, four experimental and one control. Experimental group I had on the second and third day two trials of 15 minutes each writing a given text. At the same time group II observed the activity of group I, while the third group trained mentally and group IV performed alternating trials of mental and active training. On the fourth day all groups had two trials of 15 minutes each to evaluate the different training methods.

The number of written lines were counted as plus points, the number of errors as minus points. This procedure might not be perfect, but we did not find any better scoring method.

In the first of the two final trials the active trained group improved their scores by 133.8 per cent, the observative [sic] trained group by 66.3 per cent, the mental trained group by 122 per cent, and the alternating mental and active trained group 133.8 per cent. All differences are statistically significant ($p < 0.0050$).

Combining the effects of the first and second final trial the mental trained group

scored 15 per cent higher, the alternating mental and active trained group 25 per cent higher than the active trained one, while the observative trained group obtained 75 per cent of that score (Ulich, 1967, p.413).

In the Ulich (1967) study, all groups had two trials of 15 minutes each to evaluate the different training methods. In the pilot and the main study described in this paper, two five-minute trials each were used for both the typing pretests and posttests given to the experimental and the control groups.

Because a single measure cannot provide an estimate of variability in performance, we must always have, on any occasion, at least two measures. A pair of 2- or 3-minute measures is in fact enough, but it is probably wiser to bring test length closer to characteristic employment test durations. Compromise seems indicated on a 10-minute sample of performance consisting of a pair of 5-minute timings (West, 1969, p.537).

In the Ulich (1967) study the number of written lines were counted as plus points and the number of errors as minus points. It has been found, however, that there is no consistent relationship between speed and accuracy in any movements (Smith and Harrison, 1962). Sturt (1921) points out if we are to improve speed or accuracy or both, we must emphasize speed or accuracy or both respectively.

If the learner is permitted to arrive at an optimal level of speed and accuracy in doing a task, then different types of practice should, theoretically, reveal how

either speed or accuracy is affected by said practice. In this way, it is hypothesized that the different types of practice will affect these two dimensions of successful performance in different ways but no exact a priori predictions as to the direction of differences can be made (Smith and Harrison, 1962, p.301).

Therefore, in both the pilot study and the main study in this paper, speed and accuracy were considered separately from each other.

In the Ulich (1967) study, the time spent on each alternating covert and overt training period was fifteen minutes. Twining (1941, p.435) notes that, "Introspective comments recorded by subjects during mental practice indicate that genuine mental effort was effective for only about the first five minutes of each practice period. Beyond this concentration became increasingly difficult." Egstrom (1965, p.475) used five minute periods for conceptualizing practice and stated that, "A few reported a tendency to become partially distracted at times." Using these studies as a guide, five minute periods would seem adequate for covert practice of typewriting skills.

In this study, overt practice immediately followed each covert practice. Both Richardson (1967b) and Kelsey (1961) mention the importance of feedback in covert practice. Richardson (1967b, p.270) writes, "As knowledge of results

is rewarding and has motivational as well as cognitive (informational) effects, it is especially important to control this factor as far as possible." Egstrom (1956) in making some generalizations on covert practice states that motor skills are very difficult to acquire under circumstances where knowledge of results is delayed, as in the case of conceptualizing practice, and that there appears to be some advantages in the use of a method which alternates manual and conceptualizing practice during the learning of a motor skill. With regard to his own study he states, "Perhaps the inclusion of a period of manual practice between periods of conceptualizing practice [i.e., practice in conceptualizing] provided reinforcement through additional knowledge of results and heightened sensory impressions which resulted in more meaningful perceptions and subsequent improved performance (Egstrom, 1965, p.479)."

2. Pilot Study

Following up on the Ulich test, a pilot study was undertaken in February, 1974, in Montreal, in order to test the methodology proposed for the main study. Two groups of students who were in the fourth semester of two CEGEP*

*CEGEP: The province of Quebec's Collèges de l'enseignement générale et professionnelle offer both pre-university education (2 years) and career oriented programs (2 and 3 years) similar to those offered in Ontario's Colleges of Applied Technology.

typing classes were used. All the subjects were female and ranged in age between 18 and 21. There were ten subjects in the experimental group and 17 in the control group. The testing consisted of four one-hour periods spread over two weeks.

The ten experimental subjects had alternate covert and overt practice. The control group ($N = 17$) had overt practice only. The students who had covert practice were instructed to read their assignment and think of it in terms of typing it, i.e., to read it as if they were typing it. Each separate practice was for five minutes. This follows the studies of Twining (1941) and Egstrom (1965) described on page 12 of this paper.

On the third day of the study, a Skill Builder Controlled Reader was used for the control typing tasks. This device is a film-strip projector with display rates for typing training materials ranging between 12 and 108 words per minute in six word-per-minute steps. Since none of the students in the control group were familiar with this projector, it was thought that using this device would provide a test condition for this group which would compensate for a possible Hawthorne effect in the experimental group.

It was noted on page 11 that speed and accuracy

should be studied separately. Therefore, in both the pretest and the posttest, the students were measured for (1) gross speed and (2) accuracy. Both the pretest and the posttest consisted of two five minute typing tests, following the recommendation of West (1969).

Table 1 shows the experimental and control conditions and summarizes the results.

Both the experimental group and the control group improved in speed and accuracy under test conditions. The control group showed the largest increase in speed, 10.32%, while the experimental group increased only 0.85%. The experimental group, however, showed a decrease in errors of 29.52% compared with a decrease in errors of 17.46% for the control group. Although in the predicted direction, the results were not statistically significant at the .05 level of confidence. Significant results might have been obtained with a larger group of students.

Then students in the experimental group filled in a questionnaire dealing with their attitude toward covert practice (see Appendix A). It was decided that questions 1,2,3, and 6,7,8 of the questionnaire were the most indicative of the general attitude of each student toward covert practice; therefore, the total responses to these

TABLE 1

Pilot Study Experimental and Control Conditions and Results

<u>Experimental</u>		<u>Control</u>	
Covert/Overt Practice		Overt Practice only	
<u>Day 1:</u>	5 min. warm-up 2-5 min. pretests 5 min. cp ^a and 5 min. op ^a	5 min. warm-up 2-5 min. pretests 2-5 min. typing tasks	
<u>Day 2:</u>	5 min. warm-up 2 alternate 5 min. cp/op (20 mins.)	5 min. warm-up 4-5 min. typing tasks	
<u>Day 3:</u>	Same as day 2.	Controlled Reader ^b used for 1st & 3rd typing task	
<u>Day 4:</u>	5 min. warm-up 5 min. cp/op 2-5 min. posttests Attitude test - Appendix A	5 min. warm-up 2-5 min. typing tasks, 1st with Controlled Reader 2-5 min. posttests	
<u>Average Scores</u>			
<u>Experimental</u>		<u>Control</u>	
Pretest: speed - 58.6 wpm ^c errors - 10.5		speed - 50.4 wpm errors - 6.3	
Posttest: speed - 59.1 wpm errors - 7.4		speed - 55.6 wpm errors - 5.2	

The two-tailed t-Test (Runyon and Haber, 1968) was used for statistical analysis at the .05 level of significance.

a - cp - covert practice; op - overt practice

b - Except for the Controlled Reader the same materials were used in both classes.

c - wpm - words per minute.

questions are shown separately in the top section of Table 2. The scale ranged from 1 to 3, with 3 being the most positive and 2 being neutral. The mean for the responses was 2.1 which is slightly positive.

The responses to questions 4 and 5 are shown below in Table 2. The mean for these responses is 2.05, which is slightly to the positive side of the neutral response of 2.

Discussion

Although the original subjects numbered ten in the experimental group and 17 in the control group, only five in each class were at all four classes. Bad weather and conflicting school events caused poor attendance. Therefore, the experimental sample was too small to produce reliable results.

As the control group was a larger class than the experimental group in the beginning, five of the students in the control group were assigned to do covert practice while the others acted as the control. This was not a satisfactory arrangement. Some of the covert practice students seemed to feel that the students who were actually typing were "getting ahead" of them, became discouraged and just sat and looked around the room until the five minute practice period was over. However, for the physical practice

TABLE 2

Pilot Study Attitude Questionnaire
Experimental Group (N = 10)

Questions 1,2,3 and 6,7,8

	negative	neutral	positive	\bar{x}
1. liked covert practice	3	2	5	2.2
2. found it helpful	2	4	4	2.2
3. found it relaxing	2	1	7	2.5
6. will use in future for typing	6	3	1	1.5
7. will use in future for other subjects	2	3	5	2.3
8. will use in future for practising sports or learning other motor skills	5	0	5	2.0
grand mean =				2.1

Questions 4 and 5

4. used covert practice outside of class for typing	5	1	4	1.9
5. used covert practice for other subjects since sessions began	4	0	6	2.2
grand mean =				2.05

group, the split class did provide a "test condition." On day 3, a Skill-Builder Controlled Reader was introduced into the control group practice. This was used for the same amount of time as the covert practice was used in the experimental group. This appeared to be a satisfactory way of providing a test condition for the control group in the main study. Therefore, this procedure of using intact classes was retained for the main study.

The results of the attitude questionnaire were just barely above neutral. Although useful, these findings suggested that a more sensitive instrument was needed to reflect shades of opinion. Therefore, the opinion scale was enlarged from a 3 point scale to a 5 point scale for the main study which is described in Chapter III (See Appendix B for 5 point scale). It was also decided that an attitude questionnaire should be included in the main study for the control group (See Appendix C).

The pilot study was useful because different methods of test procedure were examined under classroom conditions making it possible to develop a standardized methodology for the main study.

In summary, the review of the literature suggested that covert practice is helpful in the learning of a motor skill and the pilot study appeared to support this view.

CHAPTER III

STATEMENT OF HYPOTHESES AND MAIN STUDY

The present chapter describes the hypotheses and the main study. The objective of this study was to follow Ulich (1967) in determining whether covert practice is a useful procedure in the learning of typewriting skills. It was designed to be more conclusive than the pilot study described in Chapter II, but as in the pilot study, speed, accuracy and the attitude of the students were to be measured. Therefore, the following operational hypotheses were devised:

- OH₁ There is no difference in mean typing posttest speed measured between the experimental group and the control group.
- OH₂ There is no difference in the mean number of posttest errors measured between the experimental group and the control group.
- OH₃ The weighted mean for experimental attitude scores is not below neutral.

The variables were as follows:

Independent: kind of typing done (alternate overt/covert practice or overt practice only).

Dependent: (a) typing speed in words per minute, determined by the posttest; (b) typing accuracy, determined by the number of errors made in the posttest; (c) attitude, as indicated by the sum of the questions 1,2,3 and 6,7,8 on the questionnaire given to the covert practice students (See Appendix B).

Moderator: (a) previous speed in typing, determined by the pretest; (b) previous accuracy in typing, determined by the pretest.

Intervening: (a) improving typing skills by practising at times other than experimental periods; (b) amount of interest in testing procedure; (c) anxiety states associated with typewriting tests.

Procedure for the Main Study

Population and Sample

Subjects were drawn from second semester CEGEP typing classes in the Montreal area. Five typing classes were made available for the experiment. The experimental group initially consisted of three classes totalling 28 students while the control group initially consisted of two classes with a total of 36 students. The subjects were all female and

ranged in age between 17 and 21. There were no extremes in physical or mental abilities. The students pre-treatment typing speed ranged from 37 to 62 words per minute with a mean of 50 wpm.¹ Approximately half the students in each group had had up to one year of previous typing experience although some with the most experience were among the slowest typists.

Data for two of the experimental groups (N = 11) were separated from the remaining experimental group on the grounds that non-relevant factors might have interfered with their treatment. On the day of the final test a new ceiling was being installed in the classroom being used by both these groups. In Chapter IV, additional justification for excluding these experimental subjects is given. Their results are compared, in that chapter, with the subjects who had not had this interference.

From the original sample of 36 students in the control groups, only 24 were used in the final sample. Four of the excluded control students failed to hand in their posttests and the remaining eight were absent for one or more days of the treatment. Thus attrition factors made necessary a study comparison of 12 experimental subjects and 24 control subjects.

¹wpm - words per minute

Method

In this study, on Day 1, all the experimental groups and the control groups were given two, five-minute typing pretests which were scored for (a) gross speed and (b) errors. There was a rest period of approximately three minutes between tests. After the treatment all groups were given two more five-minute typing tests which were also scored for (a) gross speed and (b) errors.

The study took place two days each week over a two-week period for each group during the regular classroom time. During these two weeks the total class time of one hour was used for this study.

At the beginning of each of the four one-hour classes, all groups were given a five minute warm-up period in typing.

After the warm-up, on the first day, all groups were given the two five-minute pretests.

At the beginning of each period all groups were told what they were going to do that day and approximately how long each exercise would take.

On Day 1, following the pretests, the experimental groups were given a brief background description of covert practice and were handed printed material which they were asked to read "in terms of typing," that is, they were to

imagine they were typing what they were reading. They were asked to either put their hands on their lap or on the table in front of them, whichever way they felt more comfortable.

(See Appendix D for an example of the actual instructions.) The instructions were standardized and given every day before the practice. It was also impressed on them that their typing tests would not be used for any school records and that they were taking part in a study in which their results would be used but not their names. They were encouraged to ask questions in order to clarify procedure.

In the control groups, a Controlled Reader was used instead of covert practice. Typing material was flashed on the screen at increasing speeds so that the students would try to type more quickly in order to keep up with it. This apparatus is thought to help increase typing speeds. None of the students in the control groups had been exposed to a Controlled Reader before; hopefully, it provided a satisfactory test condition offsetting a possible Hawthorne effect in the experimental groups. The Controlled Reader was used for five minutes. Following this, the control groups were given a five minute typing practice using the same material as the experimental groups.

On the second and third class days the experimental

groups were given two five-minute covert practice periods and two five-minute typing practices, one typing practice following each covert practice.

On Days 2 and 3, the control groups had two five-minute practices with the Controlled Reader, each followed by a five minute typing practice.

On the final day the experimental groups had one five-minute covert practice followed by one five-minute typing practice, while the control groups had five minutes work with the Controlled Reader and then a five minute typing practice. The students in all groups were asked to check every five-minute typing task immediately after they had finished it, marking for speed and errors. In this way they were provided with feedback on the results of their work. This also gave them a brief rest period between typing periods. At the end of Day 4, all groups were given two five-minute typing posttests which were later scored for speed and errors. All groups were then given an attitude questionnaire which they were asked to hand in unsigned (See Appendices B and C).

All the stimulus material was matched for syllabic and stroke intensity. Syllabic intensity is the "average number of speech syllables per dictionary word and stroke

intensity [is the] average number of typewriter strokes per dictionary word, including interword space (West, 1969, p.530)." Two of the typing teachers made the decision as to what typing material was suitable. The same stimulus material was given to each class in the same order. Appendix E is an example of the stimulus material.

Table 3 summarizes the experimental conditions.

Scoring

A list of standards for scoring speed and errors was drawn up. Some examples are: the omission of a word or a line was one error; a letter typed so lightly that it would have to be re-typed was one error, etc. Two people independently scored each test for speed and errors. The scores were compared, and any differences were reconciled according to standards which the two judges had previously agreed upon and which were generally consistent with other studies (West, 1969).

The attitude questionnaire, given to the experimental groups consisted of eight questions each with a five point scale ranging from very negative (1) to very positive (5), with 3 being neutral. Questions 1, 2, 3, and 6, 7, 8 were scored separately from 4 and 5. Questions 4 and 5 were estimates of time spent on covert practice outside of class

TABLE 3
Experimental Conditions
for the Main Study

<u>Experimental Groups</u>	<u>Control Groups</u>
Day 1: 5 min. warm-up 2-5 min. pretests 1-5 min. cp: 1-5 min. op	The procedure was the same as for the experimental groups except that a Controlled Reader was used in place of the covert practice.
Day 2: 5 min. warm-up 2 alternating 5 min. cp and op	"
Day 3: Same as day 2	"
Day 4: 5 min. warm-up 1-5 min. cp: 1-5 min. op 2-5 min. posttests Attitude test	"

while the other questions 1,2,3, and 6,7,8 asked about attitudes concerning covert practice (Appendix B). The arithmetic mean was obtained for each question, and for the sum of 1,2,3, and 6,7,8, as well as for the total of 4 and 5, (Table 5, page 35).

The control groups were also given a questionnaire containing four questions with a five point range (Appendix C). The arithmetic mean was obtained for each question as well as for the sum of all the questions (Table 6, page 37).

Due to various reasons for attrition, the final sample numbered: experimental group = 12; control group = 24.

In this chapter, the hypotheses were stated. Also described were the method, the population and sample and the scoring of the main study. The results are given in Chapter IV, followed by a discussion and suggestions for future research.

CHAPTER IV

RESULTS AND DISCUSSION

Results

Speed. The first hypothesis states that the two methods; alternate covert-overt practice and overt practice alone are equally effective in bringing about an increase in speed in typing.

As mentioned on page 22, the results of two of the experimental groups ($N = 11$) were questionable because of the posttesting environment. The noticeable distraction of the students was reflected in the standard deviation of the speed posttest which was 13.92 as compared with 7.65 for the speed posttest of the other experimental group and 6.67 for the control group speed posttest. An F-test was performed on the speed posttest variance of the excluded experimental group vs. the experimental group whose results were used. ($F = 3.66$; d.f. = 10, 11; $P < .05$). This large difference in variance justified the exclusion of the group that had the difficult testing environment. It is interesting to note, however, that the excluded group showed the

same trends as did the other experimental group in both the pilot and the main study, i.e., a gain in speed and a reduction in errors as indicated in Table 4.

The final experimental group's pretest speed of 47.5 wpm was much lower than that of the control group for pretest speed, 52.1 wpm. Because there was no a priori expectation that the experimental group pretest speed would be different from the control group pretest speed, a two-tailed t-test was performed on these scores.

The control group pretest speed exceeded the experimental group pretest speed by 2.04 wpm. A two-tailed t-test shows this difference: ($t = 2.04$); ($p < .05$).

The experimental group's pretest mean speed was 47.5 wpm and the posttest mean speed was 52.0 wpm, which was an increase of 9.47%.

The control group's pretest mean speed was 52.1 wpm and the posttest mean speed was 52.8 wpm or an increase of 1.34%.

Both the experimental group and the control group improved in speed under test conditions. However, the mean speed for the experimental group increased to a larger extent than that of the control group.

The difference in speed of the two groups at the

TABLE 4

Average Pretest and Posttest Speed and Errors
of the Experimental Group, the Control Group
and the Excluded Experimental Subjects

	Average Speed (wpm)		
	Pretest	Posttest	Increase
Experimental Group	47.5	52.0	5.5
Control Group	52.1	52.8	0.7
Excluded Experimental Subjects	53.3	54.7	1.3

	Average Errors		
	Pretest	Posttest	Decrease
Experimental Group	11.3	9.7	1.6
Control Group	11.7	12.3	-0.6
Excluded Experimental Subjects	17.1	15.5	1.6

beginning of the tests was statistically significant at the .05 level of confidence, with the control group being larger; but there was no significant difference after the treatment. This would indicate that the increase in typing speed of the experimental group was of sufficient magnitude to reject the null hypothesis. Specifically it appears that the experimental group increased significantly compared to the control group. This analysis is consistent with the observation that the experimental gain appeared larger than the control group gain.

Errors. The second hypothesis states that the two methods, alternate covert/overt practice and overt practice alone are equally effective in bringing about more accuracy in typing.

For the experimental group, the mean of the pretest errors was 11.3 and for the posttest 9.7 which was a decrease of 14.16%. The control group's mean of pretest errors was 11.7 and it increased in the posttest to, 12.3, which is an increase of 5.13%. (See Table 4). Only the experimental group decreased in errors under test conditions. The errors for the control group, in fact, increased.

The average pretest errors for each group were not

significantly different: ($t = 0.25$); ($p > .20$). Thus, a one-tailed test was justified for the statistical analysis of posttest errors.

The difference in errors for the two groups, using a one-tailed t-test was 1.33 for the posttest which is statistically significant at the .10 level. Although the .10 level of statistical significance is not low enough to justify rejecting the null hypothesis, it does indicate a strong trend toward the reduction of errors in the experimental group (see Table 4).

Attitude Questionnaires

The third hypothesis is that the weighted mean for experimental attitude scores is not below neutral. The attitude was measured by the weighted mean of the group for questions 1, 2, 3, and 6, 7, 8. The scores ranged from one through five, with five extremely positive, and three neutral. The mean score of questions 1, 2, 3, and 6, 7, 8 was 3.4, which is slightly positive with respect to the neutral 3 (see Table 5). Therefore, the hypothesis was accepted. It is interesting to observe that the experimental group put 74% of the total number of checks for the above six questions in the neutral or positive categories. Specifically it appears that most of the students were neutral or positive

concerning the treatment.

Questions 4 and 5 asked whether the students had used covert practice outside of class during treatment. They related to student estimates rather than attitudes, therefore they were scored separately from the other questions. The number of times neutral or positive was checked for questions 4 and 5 was 14, or 44% of the total, while 18 marks, or 56%, were put in the negative category. The mean score of questions 4 and 5 was 2.6. The results indicate that the students did not feel that they were using this practice very much outside of class (see Table 5).

Sixteen students in the experimental group answered this attitude questionnaire. Four of these students were not present for all the practice periods, so they were not among those numbered in the speed and accuracy tests which were $N = 12$.

Control Group. Four of the students who filled in the attitude test for the control group did not hand in their final typing tests and two other students who handed in an attitude test were not present for the first session of the treatment. This accounts for the difference in the number of subjects in the attitude sample, $N = 30$ (see

Table 6) and the number of subjects in the control group speed and accuracy tests, $N = 24$.

Seven students in the control group noted in the comments section of the questionnaire that they felt that the Controlled Reader had been helpful in increasing their speed but that their errors had increased as well. This effect was also shown in the results of their speed and accuracy tests where their speed increased 1.34% and their errors increased 5.13%.

The total number of times neutral or positive was checked was 90 which means that 75% of the marks were put in the neutral or positive category, while 30 marks or 25% were put in the negative category. The mean score of these questions was 3.4. The scores ranged from 1 through 5, with 5 extremely positive and 3 neutral. (See Table 6).

It is interesting to note that the mean scores of the attitude questionnaires for both the experimental group and the control group were identical, 3.4. Since the attitude was similar toward both testing procedures, the difference in results was probably due to the difference in treatment rather than to whether the students liked their particular treatment.

Only Questions 1 and 2 were common to the experimental

TABLE 6

Attitude Questionnaire for Control Group
(N = 30)

	strongly negative	negative	neutral	positive	strongly positive	\bar{x}
1. liked speed practice	2	7	3	15	3	3.3
2. found it helpful	0	10	5	13	2	3.2
3. found it stimulating	6	2	2	20	0	3.2
4. would like to have it again from time to time	3	0	5	18	4	3.7
grand mean = 3.4						

and control questionnaires. The mean scores of Question 1, i.e., whether they liked their particular practice sessions, were an identical 3.3. According to the data from Question 2, the experimental group felt their sessions had been more helpful (mean scores = 3.8) than the control group did (mean score = 3.2).

In summary, both groups had a slightly positive attitude toward their respective treatment.

Discussion

The findings of this study appear to support a theory that covert practice is effective as a method for improving typing ability. In the experimental group there was a significant increase in speed, and the analysis for errors indicated a strong trend toward improvement in accuracy. These findings are similar to those of the pilot study and the same trend appears in the results of the excluded experimental subjects in the main study.

Typing ability varies with aptitude and interest. Some students learn to type very quickly because of previous piano experience, etc. Thus it is very difficult to find an evenly matched sample. Therefore, the deviation from the mean in any typing group is usually large, and it is difficult to ascertain the difference between means.

Because the mean of the experimental group was so much lower than the mean of the control group for pretest speed it was difficult to predict the final result. Therefore, a two-tailed test was used for the statistical analysis. Such an indirect procedure, as the one used here, would not be necessary for evaluating the treatment if the experimental and control groups were more closely comparable before the treatment.

The superiority of the gain in speed of the experimental group is interesting. The control group, rather than just being given regular typing practice, was exposed to the Controlled Reader which is designed to increase typing speed. While both groups increased in speed, the gain in the experimental group was much larger than in the control group.

The means for both groups for pretest errors were so similar (11.3 for the experimental group and 11.7 for the control group) that a one-tailed t-test was justified for comparing posttest errors. The posttest data indicated that the experimental group errors had decreased 14.16%, while the control group errors increased 5.13%. Although the contrast between the experimental and the control group was not significant at the .05 level, there was a strong trend ($p < .10$) in favour of the experimental group. Four of the students in the control group who were present for the

posttest did not hand in their tests. It was found in the past that students who had high errors did not want to hand in their papers. Also several students wrote on their questionnaires that their errors had increased with their speed. It may be assumed, therefore, that had the missing papers been handed in, they would have resulted in increased errors for the control group. Thus the contrast of the experimental and control groups might have reached the predetermined statistical significance level of $\alpha = .05$. In addition, if the 48% attrition in the final experimental group had not occurred, the statistical tests would have been more sensitive to real differences between the experimental and control posttests.

According to the questionnaires, the experimental group and the control group had a favorable attitude toward the particular treatment they received.

The covert practice appeared to be more difficult for the students to become involved in than the task of typing along with the Controlled Reader. At first many of the experimental students did not appear to understand what was expected of them, but by the third session it was apparent that there was a strong interest in the treatment and that the students were concentrating on their task.

It is interesting to note that in the experimental group, twelve of the sixteen students questioned thought

that they would continue mixed covert and overt practice in the future for typing; several felt that they could transfer this practice to other kinds of learning. If such transfer effects actually do occur, the students will have been trained to use covert practice as a general skill applicable in all their learning.

In comparing the main study with the pilot study, the same trends appeared in both. The increase in speed, however, was greater in the main study, while the decrease in errors was larger in the pilot. In the Ulich test, the errors were subtracted from the speed, rather than being scored separately as was done in this study. However, both studies described in this paper supported Ulich's findings that mixed covert and overt practice improved student typing scores.

In general, the results of this study appear to support a theory that mixed covert and overt practice is effective as a method of improving motor skills. Other investigations have reported similar evidence supporting such a theory. Oxendine (1969, p.762) states, "A schedule combining both overt and mental trials can prove as valuable in the learning of a motor task as a schedule in which all trials are overt." Describing the learning of a simple

hand eye coordination skill, Stebbins (1968, p.720) concludes that "the greatest amount of improvement is made by using a combination of practice conditions."

The findings of this study suggest that some practical applications of covert practice could be made in the teaching of typewriting. As West (1970, p.208) points out, this method could be applied "in class to any situation in which for one reason or another the student (temporarily) has no typewriter." West also suggests that some homework assignments using covert practice for typing would be helpful to the students. Cardboard facsimiles of the typewriter keyboard could be used as an aid to covert practice and would be especially helpful in early keyboard learning. The student could rehearse a few simple sentences while looking at the keyboard. Another advantage of this kind of keyboard is that noise during practice is eliminated and thus many places become available for study, for instance, even a bus on the way to school.

Typewriters are expensive but cardboard replicas of the keyboard would be very inexpensive. Students, who normally cannot afford typewriters, would be able to practice using this method. In terms of cost vs. educational benefits, this procedure would be useful and could be used for simple overt practice as well, although the benefit of

feedback would not be available.

Perticone (1969, pp.1-2) mentions that stimulus novelty has been found to be one aspect of external stimulation which is related to attention and manipulation. West (1970, p.395) also points out in regard to typewriting courses, "varying the activities is a sound antidote or preventive for the loss of motivation resulting from boredom." Covert practice could provide a stimulus novelty in a course such as typing where so much repetition and drill are necessary.

In conclusion, both the pilot study and the main study described in this paper indicated that there was a trend toward improvement in both speed and accuracy through the use of mixed covert and overt practice. The limitations of the study were: a small sample due to attrition; a short testing time - only four, one-hour sessions over a two week period; only female subjects of a certain age range were tested; only some of the findings were significant. The results, however, do show a similar pattern of improvement as obtained in many other studies surveyed in the literature.

Recommendations for Future Study

Studies in typing controlling different variables such as IQ, past experience, age and sex would indicate.

whether these factors had any moderating effects on the teaching of typing.

Bigger samples are needed to allow more confident results to emerge than was the case in this study where attrition was a problem. A study involving first year high school students would give a more homogeneous grouping than students at the CEGEP level. These students would be younger and thus less apt to have had previous typing experience. Attendance, also, might be more regular than it is at a CEGEP, thereby ensuring a larger sample.

A study using more periods for covert practice could give more conclusive results than this study, which had only four practice sessions. No research has been done on the length and proportion of mixed covert and overt practice which would give the maximum value in relation to the time spent.

Simple replicas of typewriter keyboards might be designed and tested. The cost, durability and convenience of various materials such as cardboard, plastic or canvas, etc., could be considered. These keyboards could be used to promote early keyboard learning with covert practice. They could also be used in covert learning when the stimulus material is oral dictation from a tape.

Tests of mixed covert and overt practice mentioned above could be used for many kinds of motor skills in sports and in the industrial arts. In fact, covert practice should prove helpful in developing habits of thought and kinesthetic awareness in a variety of areas; in situational planning and developing and rehearsing strategies in sports and athletic games (Oxendine, 1968). Mixed covert and overt practice might also prove useful in developing skills in the more traditionally academic subjects, such as geography (map drawing) and mathematics (conceptualizing the several steps necessary to solve a geometry problem).

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APPENDIX A

ATTITUDE TEST USED IN THE PILOT STUDY

1. Did you like doing covert practice?

no undecided yes

2. Did you find it helpful?

no undecided yes

3. Did you find it relaxing?

no undecided yes

4. Did you find that you used covert practice at other times than during the assigned period?

no undecided yes

5. Did you find that you used covert practice on subjects other than typing?

no undecided yes

6. Do you think you will use it in the future for typing?

no undecided yes

7. Do you think you will use covert practice in the future for other subjects?

no undecided yes

8. Do you think you will use it in the future for practising sports or learning other motor skills?

no undecided yes

Any comments?

APPENDIX B

ATTITUDE QUESTIONNAIRE GIVEN
TO THE EXPERIMENTAL GROUPS

Questionnaire about typing practice (please do not sign your name)

DIRECTIONS: Circle the word or phrase which most nearly matches your feelings.

1. Did you like doing covert practice?

not	not very	undecided	fairly	very
at all	much		well	much

2. Did you find it helpful?

not	not very	undecided	fairly	very
at all				

3. Did you find it relaxing?

not	not very	undecided	fairly	very
at all				

4. Did you find that you used covert practice for typing at other times than during the assigned periods?

not	not very	undecided	sometimes	very
at all	much			often

5. Have you found that you have used covert practice on subjects other than typing since these sessions began?

not	not very	undecided	sometimes	very
at all	much			often

6. Do you think you will use it in the future for typing?

never	probably	undecided	sometimes	very
	not			often

7. Do you think you will use covert practice in the future for other subjects?

never	probably	undecided	sometimes	very
	not			often

8. Do you think you will use it in the future for practising sports or learning other motor skills?

never	probably	undecided	sometimes	very
	not			often

Any comments? (for example, what you liked about participating in the study, and what you disliked; recommendations on how covert practice might be used in classes, etc.)

Write here or on back

APPENDIX C

ATTITUDE QUESTIONNAIRE GIVEN
TO THE CONTROL GROUPS

QUESTIONNAIRE ABOUT TYPING PRACTICE

(please do not sign your name)

1. Did you like doing this form of practice?

not	not very	undecided	fairly	very
at all	much		well	much

2. Did you find it helpful?

not	not very	undecided	fairly	very
at all				

3. Did you find it stimulating?

not	not very	undecided	fairly	very
at all				

4. Would you like to have this type of practice again from time to time?

not	not very	undecided	sometimes	often
at all	much			

Any comments? (for example, what you liked about participating in the study, and what you disliked; recommendations on future use, etc.)

Write here

APPENDIX D

NOTES ON PROCEDURE

NOTES ON PROCEDURE

Both the experimental groups and the control groups were told that they were part of a study testing different methods of learning how to type.

On the first day all groups were told how long the study would take and on which days of the week and how long each exercise would take.

Each day each group was told what was to take place that day and how long each exercise would take.

The only part of the study which was not mentioned beforehand was the attitude questionnaire which was given after the posttests at the final sessions. It was felt that it was important that the questions be answered spontaneously.

It was impressed upon the students that only their results would be used in the study and not their names. It was necessary, however, for them to sign their pretest and posttest papers in order that these could be compared.

It was also necessary to have their names so that their attendance for the practice periods could be noted. This, however, was not mentioned. Each day their regular teacher unobtrusively checked attendance.

All five minute overt typing tasks including the pretests and the posttests were immediately scored by the

students for speed and errors. This is a normal routine used throughout the school year. The pretests and posttests were the only tasks that were handed in to the investigator and these, of course, were carefully checked by two judges, using standards agreed upon beforehand.

The four sessions in all groups were conducted by the investigator. On the first day, the regular teacher introduced the investigator and on the following days took attendance, but otherwise she was not involved in the procedure.

On Day 1, with the experimental groups, I gave a brief description of how covert practice was conducted and how, although it is a passive type of learning, there is activity going on, i.e., messages are being sent to the muscles from the brain. I pointed out that several studies had shown that this particular type of practice was found to improve certain motor skills and that most good athletes carefully planned and rehearsed their performance in their mind before the actual practice and thought about their performance afterwards as well in order to improve upon it.

No specific techniques have been established for instruction in covert practice. Some methods used include having subjects watch films (Harby, 1952), read a description of a task and "think it through" (Eggstrom, 1965),

"visualize the sensations" of a performance (Twining, 1949).

The technique used in this study was to give each student copies of printed material that are used in regular typing practice, similar to the sample shown in Appendix E. The students were told to sit with their hands on their laps or on the table in front of them, and read the material as if they were typing it as they read it, but not to actually type it.

After the pretests the material for the covert practice was handed out. The following is a paraphrase of the instructions that were given orally to the students.

"Now we are going to do some covert practice. The material that I'm handing out is to read but not type. Read it as if you are typing it. Try to feel that you are typing it while you are reading it. Concentrate on the reading material for five minutes. At the end of five minutes I will ask you to stop practising."

Each day before the group's covert practice I explained how they were to read the material as if they were typing it but not to do the actual practice.

The control groups were also told they were part of a study. Their part, ostensibly, was to work with the Controlled Reader. For the most part the instructions in the booklet which came with the Controlled Reader were followed,

i.e., to start slowly, within everyone's speed range and increase the rate of speed gradually. I tried to get a consensus of opinion on what the starting speed should be and how high the speed should go. I wanted to get everyone to feel they were involved in the study and that I was really working with them as I was with the experimental groups. I told them how before Bannister had run the 4-minute mile no one had believed it possible. After that many runners had achieved that speed. The analogy to their work was that if they tried following the Controlled Reader at a faster rate than they believed they could type, they probably would find that they could type faster. One of my main concerns was to get the control group to feel they were involved in the study and thereby establish test conditions equal to those of the experimental groups.

APPENDIX E

SAMPLE OF STIMULUS MATERIAL

The electric typewriter has made things so much easier that it is not hard to understand why the busy typist wishes to use this model. The finished work always is so much neater and many more clear copies may be made merely by regulating the copy control for the copies the typist wants. This typewriter produces clear copies whether it be for the first or the last copy.

Electric typing can be a pleasure as the typewriter does much of the work and the typist can now depend on it to a wider measure than before. There are right methods and wrong methods in writing on this model and it is wise to start out right by learning to use your lightest touch to tap the keys rather than strike them. Once you know how to tap the keys with a light stroke you can let the machine do the work for you.

Typing authorities say that one of the clues to being able to type rapidly and without making mistakes is to type without any sense of being rushed and the typist who knows how to use control in typing should be able to type rapidly and without mistakes. The operator must learn to type and read at the same time and the eye span should cover only the word that is being typed and not the words beyond that point.

Typists who wish to build up their rate should use copy that is easy to type and simple to read and the copy should contain words that they can tap at a high rate. The words should be typed as though they were just one unit for this is what typists must do when they want to raise their rates to a new high. Some words may be hard to type even though they are short words and the typist should try to stroke such words at a pace slow enough to write without mistakes.

Typists today find their work much more simple than did those in the past and they can now do rapidly what they would have found at one time to be a long and tiresome job. There were many long years of hard and persistent work on the part of the men who wanted to make the job of a typist easier and more pleasant before this came about. They knew then that typists would one day make up a vital part of the nation and they wanted just the right machine for the job.

Royal has always felt that the right typewriter for the work at hand is the one that could enable the operator to do the work in as short a time as it can be done; at the same time sparing the undue strain that sometimes results from long and tiresome periods of typing. That may be the reason why so many typists find they can be fresh as a daisy after a long job is over and why so many typists have come to depend on this fine feature.