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Contextual Interference Effects on the Acquisition, Retention, and Transfer of a Motor Skill

John B. Shea and Robyn L. Morgan
Department of Physical Education and Recreation
University of Colorado

This study was based on Battig's conceptualization that increased contextual interference during skill acquisition can lead to improved retention or transfer, especially under changed contextual conditions. Subjects learned three motor tasks under a blocked (low interference) or random (high interference) sequence of presentation. Retention was measured after a 10-min. or 10-day delay under blocked and random sequences of presentation. Subsequent transfer to a task of either the same complexity or greater complexity than the originally learned tasks was also investigated. Results showed that retention was greater following high interference (random) acquisition than after low interference (blocked) acquisition when retention was measured under changed contextual interference conditions. Likewise, transfer was greater for high interference (random) acquisition groups than for low interference (blocked) acquisition groups. This effect was most notable when transfer was measured for the transfer task of greatest complexity. These results are considered as support for Battig's conceptualization of contextual interference effects on retention and transfer. Implications for the teaching of motor skills are also discussed.

Research concerned with verbal learning and rule learning has provided evidence that learning under conditions of high intratask interference results in improved retention and, to a lesser extent, facilitation of transfer (Battig, 1972; Hiew, 1977). Battig (1978) has recently incorporated these findings into a general conceptualization of memory that is in line with the levels of processing framework for memory research (Craik & Tulving, 1975; Lockhart, Craik, & Jacoby, 1976). As part of this conceptualization, Battig has expanded his earlier interpretation of intratask interference (Battig, 1972) to represent more general "contextual interference" including factors extraneous, as well as intrinsic, to the task being learned. According to this interpretation, contextual interference is closely associated with, if not determined by, changes across trials in the experimental and processing contexts. Battig contends that contextual interference is a major determinant of the use of multiple and variable processing strategies by individual subjects. Practice under increased contextual interference can produce more elaborate and distinctive processing of the material to be learned and thus facilitate delayed retention as well as decrease the dependence of memory on the reinstatement of the original context. In addition, to the extent that contextual interference induces processing strategies appropriate for learning other material, transfer will be facilitated.

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Requests for reprints should be sent to John B. Shea, Department of Physical Education and Recreation, University of Colorado, Boulder, Colorado 80309.

There has been little research concerned with contextual interference in the learning of motor skills, except for a few studies concerned with the order of practice of two or more skills, comparing blocked (low contextual interference) with random (high contextual interference) sequences of practice. Such studies have generally been inconclusive in determining the effects of contextual interference on skill acquisition and retention (Allen, 1948; Dunham, 1977, 1978). Other research has been concerned with investigating the prediction of Schmidt's (1975) schema theory that increased amounts of practice with a number of similar tasks, as well as the variability of this practice, will result in positive *motor* transfer to a novel variation of the tasks. These studies (McCracken & Stelmach, 1977; Newell & Shapiro, 1976) have provided somewhat weak support for Schmidt's prediction, showing that transfer occurs only for tasks within the dimensions of the originally learned tasks and that this increased transfer effect appears to be quite transient in nature.

The purpose of the present study was to investigate the effects of random, as compared with blocked, practice sequences on the acquisition and retention of three similar motor skills. Retention was measured after a 10-min. delay or a 10-day delay and under either the same or different contextual conditions as acquisition. Also investigated were the effects of contextual interference during acquisition on subsequent transfer to a task of either the same complexity or greater complexity than the originally learned tasks. Since other motor skills studies concerning variability of practice have either confounded the number of tasks practiced and the number of acquisition trials (McCracken & Stelmach, 1977; Newell & Shapiro, 1976) or have not clearly manipulated the task dimension being practiced (Dunham, 1977, 1978), this study represents the first strong test of Battig's conceptualization in motor skills. In addition, no other motor skill studies have investigated the effects of changing the contextual conditions between acquisition and retention on performance.

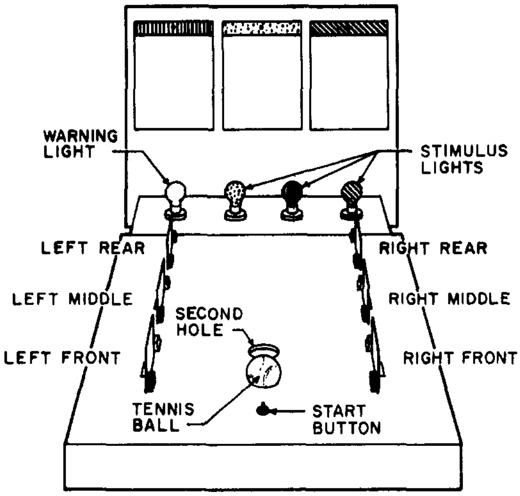

Figure 1. Diagram showing the apparatus used in the experiment form the perspective of the subject.

Method

Subjects

Subjects were 72 right-handed students (36 males and 36 females) at the University of Colorado. All subjects were unpaid volunteers from physical education service program classes.

Tasks and Apparatus

Figure 1 depicts the apparatus used in the experiment. A total of six tasks was performed by each subject. In each task, following a yellow warning light, the subject was required to respond as quickly as possible to a stimulus light. Using the right hand, the subject released the start button and grasped a tennis ball that was supported in the first of two holes located on the midline of the apparatus and directly behind the start button. While holding the tennis ball, the subject then knocked down a specified number of six freely moveable barriers in a prescribed order. Three barriers were positioned on each side of the top surface of the apparatus so that they faced the midline of the apparatus and were opposite one another. The order in which the barriers were to be knocked down was different for each task. These orders were prescribed by diagrams that were located directly behind the stimulus lights and attached to the front of a barrier that was constructed to shield the subject's view of the experimenter's activity. The top edge of each diagram was marked with the color of the stimulus light to which the diagram was to be paired. After knocking down the barriers, the subject returned the tennis ball to the second hole (located directly behind the first hole) in the top surface of the apparatus. Four millisecond timers (Hunter Klockcounter, model 120 A), located behind the shield and out of view of the subject, were used to time various components of the task. In addition to the millisecond timers, a switch was located behind the shield, allowing the experimenter to present the warning light, followed by the appropriate stimulus light, on each trial. The apparatus was wired so that the four timers started on the presentation of a stimulus light by the experimenter. One timer stopped on the completion of each of the first three components of a task. These components were the release of the start button, the grasp of the tennis ball, and the knocking down of the first designated barrier. The fourth timer was stopped on completion of the task by placement of the tennis ball into the second hole of the apparatus. The entire apparatus was supported on a wooden table that stood at about the waist level of a standing subject.

All subjects initially performed a pretest task. This task consisted of knocking down the right front barrier followed by the left front barrier and was paired with a red stimulus light.

Three tasks were practiced during acquisition trials. The acquisition tasks consisted of knocking down three barriers in one of the following orders: (a) right rear, left middle, and right front; (b) right front, left middle, and right rear; (c) left front, right middle, and left rear. Each of the acquisition tasks was paired with a different color stimulus light. Stimulus lights were blue, red, and white for Tasks 1, 2, and 3, respectively. The same three tasks practiced during acquisition trials were perforemed on retention trials.

Two tasks different from those practiced during acquisition trials were performed on transfer trials. Transfer Task 1 was paired with a green stimulus light and consisted of knocking down three barriers in the following order: right rear, left rear, and right middle. Transfer Task 2 was paired with a black stimulus light and consisted of knocking down five barriers in the following order: left front, right rear, left middle, right middle, and left rear. Transfer Task 1 was considered to be of the same complexity and Transfer Task 2 was considered to be of greater complexity than the acquisition tasks. This judgment was based on the assumption that task complexity was related to the number of barriers knocked down or directional changes in movement required to perform a task, and is generally consistent with previous motor-skills research concerning task complexity (Hayes & Marteniuk, 1976).

Design

Based on pretest task performance, subjects were assigned to either a low contextual interference (blocked) acquisition group or a high contextual interference (random) acquisition group in an attempt to make the initial ability of the two groups equal. An equal number of males and females were assigned to each group.

A total of 54 acquisition trials was administered to both acquisition groups in three sets of 18 trials, one set for each of the acquisition tasks. Subjects in the blocked group always completed all trials on one task before the next task was introduced. The order in which the tasks were administered was counterbalanced across subjects by the use of a Latin square. Subjects in the random group were given acquisition trials on the three tasks in an unsystematic sequence such that 6 trials on each of the three acquisition tasks were included in each set of 18 trials. The sequencing of trials for each task within each set of trials provided that no more than 2 trials on the same task would occur consecutively. Thus, the greatest possible amount of contextual interference was provided. These experimental manipulations resulted in a 2 (acquisition groups) × 3 (tasks) × 2 (sex) × 18 (trials) factorial design for acquisition with repeated measures on the second and fourth factors.

Half of the subjects (9 males and 9 females) in each of the acquisition groups received 18 retention trials after a 10-min. delay, whereas the other half of the subjects received 18 retention trials after a 10-day delay. A total of 6 trials was performed on each of the three acquisition tasks during the retention test. Nine trials (3 per task) were administered in a *blocked* sequence, and 9 trials (3 per task) were administered in a *random* sequence. The order in which the blocked and random sequences were administered for retention trials was counterbalanced across subjects in each of the retention groups. These experimental manipulations resulted in a 2 (acquisition groups) × 2 (retention sequences) × 2 (retention interval) × 3 (task) × 2 (sex) × 3 (trials) factorial design for retention, with repeated measures on the second, fourth, and sixth factors.

Immediately following the retention trials, all subjects received one set of three trials on each of the two transfer tasks. The order of testing for the transfer tasks was counterbalanced across subjects in each of the retention groups. These experimental manipulations resulted in a 2 (acquisition groups) × 2 (retention interval) × 2 (transfer task) × 2 (sex) × 3 (trials) factorial design for transfer with repeated measures on the third and fifth factors.

Procedure

The subject stood in front of the apparatus so that the start button was located opposite the midline of the subject's body. Prior to each portion of the experiment (pretest, acquisition, retention, and transfer), the subject was instructed that the objective of the task was to release the start button, grasp the tennis ball, knock down certain barriers in a prescribed order, and return the tennis ball to the second hole in the top surface of the apparatus as quickly as possible in response to an appropriate stimulus light. In addition, the subject was instructed that the start button should not be released until the subject was ready to proceed at full speed.

Only those stimulus lights and diagrams designating tasks to be performed during the portion of the experiment in which the subject was being tested were present. Thus, only one stimulus light and diagram were present during the pretest portion of the experiment and when subjects were being tested in the blocked conditions. However, three stimulus lights and diagrams were present when subjects were being tested under random conditions.

To signal the beginning of a trial, the experimenter said "ready," at which time the subject depressed the start button with the index finger of the right hand. Two sec later the yellow warning light was presented. Either 1, 3, or 5 sec following the warning light, a stimulus light was presented. The length of the interval between the presentation of the warning light and the onset of a stimulus light was randomly varied over trials. At the onset of a stimulus light, the subject performed the appropriate task as quickly as possible. If the subject knocked the barriers down in the wrong order, a mistrial was noted and the trial was repeated at the end of the set of trials on which the subject was being tested. Following the completion of the subject's response, the experimenter recorded the total elapsed time in seconds between the onset of the stimulus light and the release of the start button; the lifting of the tennis ball, the knocking down of the first designated barrier; and, finally, the placement of the tennis ball in the second hole of the apparatus. However, because of data-processing limitations, only the first and fourth response component times were fully analyzed and will be reported. During acquisition trials knowledge of results concerning the total time in milliseconds taken to perform the task was provided by the experimenter 10 sec after the completion of the subject's response. Ten sec following knowledge of results, the experimenter said ready to signal the beginning of a new trial. Thus, the intertrial interval was approximately 20 sec in duration. This procedure was followed for all trials throughout the experiment with the exception that knowledge of results was not provided on pretest, retention, and transfer trials. In addition, a 3-min rest interval was provided between each set of 18 acquisition trials. All other intervals during each portion of the experiment (pretest, acquisition, retention, and transfer) were 20 sec in duration.

Results

The total time (TT) in seconds between the onset of the stimulus light and the completion of the subject's response by placing the tennis ball in the second hole of the apparatus was considered to be the overall index of skill performance. For a more refined analysis, reaction time (RT) and movement time (MT) measures were also analyzed. RT was the time in seconds between the onset of the stimulus light and the release of the start button. MT was the time in seconds between the release of the start button and the placement of the ball into the second hole. In addition, the number of trials on which errors were made was obtained for each subject.

TT, RT, and MT scores for the 54 acquisition trials, 18 retention trials, and 6 transfer trials for each subject were averaged into blocks of three for each task for analysis.[1] Too few errors were made during transfer for a meaningful analysis of these data. Figure 2 shows mean TT measures across blocks of three trials and collapsed over sex and tasks for the blocked and random groups for acquisition and retention. Each data point of this figure represents the average of 9 trials, or the average of 3 successive trials for each of the three acquisition tasks. For example, the first point in the left half of the figure (acquisition trial blocks) represents the first 3 trials on each of the three tasks (i.e., the average of Trials 1–3, 19–21, and 37–39 for the blocked group). In all analyses, the rejection region was $p < .05$. The locus of any significant effects was identified by a Newman-Keuls post hoc analysis.

Acquisition

A four-way analysis of variance over acquisition groups, task, sex, and trial blocks performed on TT, RT, and MT measures for acquisition. A one-way analysis of variance was performed on error data pooled across trials, task, and sex.

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[1] To avoid confusion the term *blocks* will be used to designate the averaging of measures over 3 trials, whereas the term *sets* will be used to refer to the administration of successive trials during each portion of the experiment (e.g., three sets of 18 trials during acquisition).

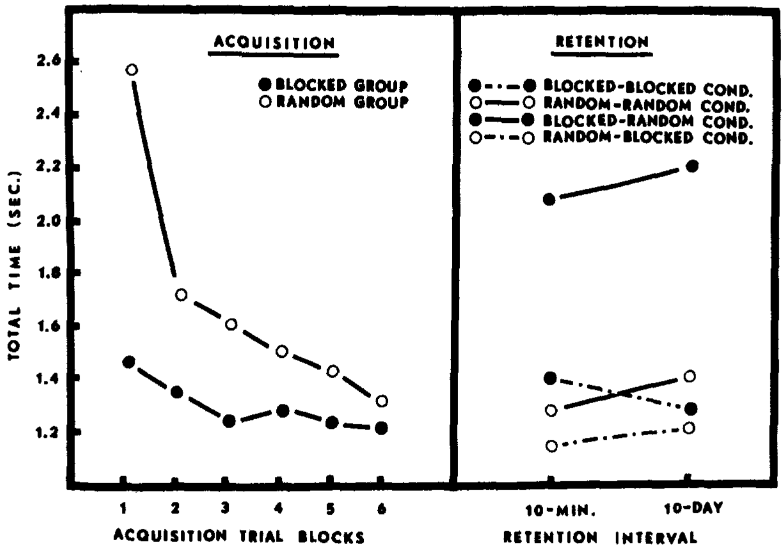

Figure 2. Mean total time measures in seconds computed in three trial blocks and collapsed over sex and tasks for acquisition blocked and random groups and retention conditions. [These conditions represent the acquisition blocked group when tested in the retention blocked (blocked-blocked) and random (blocked-random) sequences and the acquisition random group when tested in the retention blocked (random-blocked) and random (random-random) sequences.]

Figure 2 shows that the blocked group performed considerably faster than the random group during the early acquisition trials. There was little decrease in TT for the blocked group over trials, whereas the TT for the random group decreased greatly over trials so that there was little difference between the two groups on the final block of trials. Table 1 shows mean TT, RT, and MT measures, F ratios, and MS_e terms for the acquisition groups for the acquisition analyses. The analysis of variance performed on TT measures showed significant effects for acquisition groups, $F(1, 68) = 45.61$ ($MS_e = 45.25$), trial blocks, $F(5, 340) = 52.63$ ($MS_e = 14.50$), and the Acquisition Groups × Trials Blocks interaction, $F(5, 340) = 26.35$ ($MS_e = 7.26$). The results of the analyses performed on RT and MT measures paralleled those of TT, with the exception that sex, $F(1, 68) = 4.26$ ($MS_e = 3.39$), was significant for MT measures. This was due to the faster MT for male subjects ($M = 1.17$ sec) than for female subjects ($M = 1.27$ sec). An inspection of the mean TT, RT, and MT measures for the first acquisition trial revealed that the contextual interference effects were present on the first trial of practice. Thus, the onset of the interference effects during practice was immediate. This finding is consistent with that expected, since subjects in the random group were uncertain as to which of the three tasks they would be required to perform and were therefore unable to plan their movements in advance of the onset of the stimulus light. Subjects in the blocked group, however, were certain which task they would be required to perform and were thus able to preplan their response, which could then be initiated immediately upon the presentation of the stimulus light. The analysis of error data showed that the blocked group ($M = 4.42$) had less than half as many errors as the random group ($M = 9.13$), $F(1, 68) = 23.75$ ($MS_e = 16.90$).

Retention

A five-way analysis of variance over acquisition groups, retention interval, sex, task, and retention sequences was performed on TT, RT, and MT measures for retention.

Table 1
Mean TT, RT, and MT Measures, F *Ratios, and Mean Square Error Terms for Blocked and Random Groups for Acquisition and Retention*

Measure	Group *M*s in sec: Blocked	Random	*F*	MS_e
	Acquisition			
TT	1.32	1.69	45.61*	45.25
RT	.19	.38	89.81*	11.99
MT	1.13	1.31	13.37*	.11
	Retention			
TT	1.73	1.31	49.97*	18.83
RT	.41	.23	26.91*	3.20
MT	1.32	1.07	39.16*	6.50

Note. TT = total time; RT = reaction time; MT = movement time.
* $p < .05$.

A one-way analysis of variance was performed on error data pooled across all other factors for the acquisition groups.

Crossing acquisition groups (blocked vs. random) with the within subject variations in retenion sequences (blocked vs. random) resulted in four retention conditions at each retention interval. These conditions represented the acquisition blocked group when tested in the retention blocked (blocked-blocked) and random (blocked-random) sequences, and the acquisition random group when tested in the retention blocked (random-blocked) and random (random-random) sequences. Figure 2 shows that both 10-min. and 10 day retention performances were particularly poor for the blocked-random condition. For the 10-min. retention interval, TT was faster for both the random-blocked and random-random conditions than for either the blocked-blocked or blocked-random conditions. For the 10-day retention interval, however, performance was slightly faster for the blocked-blocked condition than for the random-random condition.

Table 1 shows mean TT, RT, and MT measures, *F* ratios, and MS_e terms for acquisition groups for the retention analyses. The analysis of variance performed on TT measures showed significant effects of acquisition groups, $F(1, 64) = 49.97$ ($MS_e = 18.83$), retention sequences, $F(1, 64) = 103.43$ ($MS_e = 23.78$), and a significant interaction between these two variables, $F(1, 64) = 33.80$ ($MS_e = 7.77$). In addition, no significant difference in performance was found between the 10-min. and 10-day retention intervals ($F <$). Post hoc analysis of the Acquisition Groups × Retention Sequences interaction revealed that all comparisons were significant except for that between the blocked-blocked and random-random conditions. The significant differences between both the blocked-blocked and random-blocked conditions and the blocked-random and random-blocked conditions provides strong support for Battig's (1978) contention that practice under conditions of high contextual interference will cause less dependence of memory on reinstatement of contextual factors present during acquisition.

The results of the analyses performed on RT and MT measures paralleled closely those of TT, with the exception that task, $F(2, 128) = 3.47$ ($MS_e = .05$), for RT measures and sex, $F(1, 64) = 10.25$ ($MS_e = 1.70$), for MT measures were significant. The difference between sexes was due to a faster MT for male subjects ($M = 1.14$ sec) than for female subjects ($M = 1.26$ sec). The analysis of error data showed that the random ($M = 2.10$) had significantly fewer errors than the blocked group ($M = 4.33$), $F(1, 68) = 12.85$ ($MS_e = 33.35$), and that this effect was almost entirely localized in the random retention sequence.

Subsequent analyses were conducted on TT, RT, and MT measures to determine if the order of testing for retention blocked and random sequences (blocked first and random second or random first and blocked second) had any effect within previous analyses. Only the main effect of testing order was significant, $F(1, 64) = 6.10$ ($MS_e = 2.38$), for TT. Subjects first tested in the blocked sequence ($M = 1.43$ sec) performed faster than subjects first tested in the random sequence ($M = 1.58$ sec).

Table 2
Mean TT, RT, and MT Measures for Acquisition Groups for Each Transfer Task and Acquisition Group, Task, and Acquisition Group × Task Interaction F *and* MS_e *Error Terms*

	Acquisition group means in sec											
	Blocked			Random			Acquisition group (A)		Task (B)		A × B	
Measure	Task 1	Task 2	*M*	Task 1	Task 2	*M*	*F*	MS_e	*F*	MS_e	*F*	MS_e
TT	1.42	2.04	1.73	1.33	1.84	1.58	6.93*	.07	395.43*	11.52	3.98	.12
RT	.21	2.4	.23	.20	.20	.20	4.77*	.02	6.32*	.01	4.26*	.01
MT	1.21	1.80	1.51	1.13	1.64	1.39	5.79*	.51	387.47*	10.86	2.39	.06

Note. TT = total time; RT = reaction time; MT = movement time.
* $p < .05$.

Transfer

A four-way analysis of variance over acquisition groups, retention interval, sex, and task was performed on TT, RT, and MT measures for transfer. These analyses showed that there was no retention interval effect but that acquisition groups and task effects were significant for the three dependent measures. Table 2 presents acquisition group means for the transfer tasks, and acquisition group, task, and Acquisition Group × Task interaction *F* ratios and MS_e terms. This table shows that the random group performed faster than the blocked group on all dependent measures, and that this difference was more distinct for the more complex Transfer Task 2. However, the Acquisition Group × Task interaction was significant for RT measures only, with the TT measure just falling short of significance. This finding provides support for Battig's (1978) prediction that practice under conditions of high contextual interference will lead to increased positive transfer. The task effect was significant for all dependent measures, and this effect was greatest for TT and MT because of the greater distance moved in performing Transfer Task 2. The task effect for RT measures was entirely localized in the blocked group. The sex effect, $F(1, 64) = 8.52$ ($MS_e = .92$), and the Sex × Task interaction, $F(1, 64) = 7.10$ ($MS_e = .02$), were significant for TT measures. Even though male subjects performed faster than female subjects on both transfer tasks, this difference was significant only for the more complex Transfer Task 2. The findings for MT analysis with respect to the effect of sex and the Sex × Task interaction paralleled closely those of TT. In contrast to the TT and MT sex findings, RT for female subjects was significantly faster than for male subjects except in the random group during the 10 day retention interval. This accounted for the finding that the Acquisition Group × Sex × Task interaction, $F(1, 64) = 4.26$ ($MS_e = .01$), and the Acquisition Group × Retention Interval × Sex × Task interaction, $F(1, 64) = 6.74$ ($MS_e = .01$), were significant.

Subsequent analyses were conducted on TT, RT, and MT measures to determine if the order of testing for the two transfer tasks (Transfer Task 1 first and Transfer Task 2 second or Transfer Task 2 first and Transfer Task 1 second) had any effect within previous analyses. Only the difference between the first and second transfer task to be presented was significant for MT and TT (but not RT) measures, both $Fs(1, 64) \simeq 5.0$ ($MS_e \simeq .15$). Subjects performed fastest on the transfer task on which they were first tested, possibly reflecting a small negative transfer effect between the two transfer tasks.

Discussion

This study has provided support for Battig's (1978) recent conceptualization of contextual interference in which practice under conditions of high contextual interference will lead to increased retention and transfer, especially under changed contextual conditions.[2] Findings of this study are consistent with verbal and rule-learning studies showing increased retention and transfer (Battig, 1972; Hiew, 1977) as a result of practice under conditions of high contextual interference, as well as providing strong evidence against recent findings in motor skill research that retention is unaffected (Dunham, 1978) and that any beneficial transfer effects (McCracken & Stelmach, 1977) as a result of such practice are transient in nature. Examination of the group means and F ratios presented in Tables 1 and 2 reveals a dramatic reversal of acquisition group effects from acquisition to retention and transfer. Acquisition results supported earlier studies (Allen, 1948; Dunham, 1977) showing that practice under a random (high interference) sequence impairs acquisition performance in comparision to practice under a blocked (low interference) sequence. Whereas the random group improved greatly over trials so that it differed only slightly from the blocked group by the end of acquisition trials, the acquisition difference between groups was never completely eliminated. In contrast to the acquisition findings, the retention results showed that performance following the random acquisition condition was superior to performance following the blocked acquisition condition. In addition, there was no evidence found of forgetting over the 10-day retention interval. The lack of appreciable retention differences was probably because subjects were well practiced and performance had reached asymptote. In addition, no recall was necessary to perform the tasks, since diagrams of the tasks were present throughout performance.

Similar to the retention findings, the transfer results showed that the random group performed faster than the blocked group on both transfer tasks and that there was no retention interval effect. It is interesting to note that these transfer effects were most distinct for the more complex Transfer Task 2. The finding of a significantly greater RT for Transfer Task 2 than for Transfer Task 1 is consistent with research showing RT as a positive function of response complexity (Hayes & Marteniuk, 1976). Whereas female subjects had faster RTs on the transfer tasks, male subjects had faster MTs. The faster MT performances of male subjects throughout the study can be attributed to greater muscular development than for female subjects.

A tentative explanation for the findings of this study can be offered. In the present experiment, performance in the high contextual interference condition was more difficult than in the low contextual interference condition, and the random group was forced to use multiple processing strategies to optimize its performance during acquisition, whereas no such multiple processing was necessary for the blocked group. This greater elaboration led to better retention performance, especially when the context of performance was changed, as well as, improved transfer. Hayes and Marteniuk (1976, pp. 213, 221) have suggested that RT can be related to the time necessary to transform input information into an appropriate response and MT can be related to processes that take place between the initiation and termination of a response, most notably the

[2] It should be noted that the finding of greater transfer for the random acquisition group than for the blocked acquisition group also seems consistent with Schmidt's (1975) schema theory. However, Schmidt does not provide any theoretical rationale for why a random practice schedule per se should influence transfer when the number of tasks practiced is held constant and does not address the problem of contextual effects on retention and transfer. In addition, the finding of greater transfer for the random group than for the blocked group on the more complex Transfer Task 2 is difficult to reconcile with Schmidt's (1975) theory, since he explains transfer as the result of "*interpolations* among past specifications" (p. 236, italics added). Strictly speaking, subjects in this experiment did not perform a task with as many components as Transfer Task 2 prior to transfer. However, Schmidt's predictions are concerned only with transefer of a *motor* response and the present authors do claim that their results represent perceptual and cognitive processes in addition to the motor component of skill performance.

number of feedback corrections required when executing a response. The present RT and MT findings would suggest that acquisition under conditions of high interference leads to greater flexibility in those mechanisms responsible for the structural organization of response units underlying movement initiation and control. That is, the faster RTs of the random group compared to the blocked group during retention and transfer can be attributed to a more efficient transformation of input information into an appropriate response. This interpretation is probably true for only the early stages of a response, since in responses of temporal durations as long as the ones studied in this experiment, subjects very likely program only the initial stages of movement prior to the initiation of the response (Klapp & Wyatt, 1976). The present MT results are consistent with this interpretation in that fewer feedback corrections of the response would be necessary for the random group than for the blocked group during retention and transfer because of the relative accuracy of the initially selected response units.

The findings of this study can be readily applied to the educational setting. Most instructors of motor skills teach one skill per session in order to avoid confusing the student, presumably giving the student the opportunity to learn the skill completely before attempting to learn a similar skill. However, the results of this study suggest that instructors should instead teach a number of skills during each session for a number of sessions in order to achieve maximum retention and transfer. Assuming that the present results can be applied to movements that differ in some respects from those of this study, instructors should be willing to incorporate this method into their teaching at the risk of seeing little progress during early acquisition trials.

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