Influence of Practice Schedule on Practice Variability in Kinematometer Task

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Abstract

The purpose of this study was to examine the influence of practice schedule on practice variability. Two experiments were conducted to assess the possibility that random order may be facilitate learning effect in adult subjects compared to a blocked fashion. Using a kinematometer task, undergraduate students learned a angular recall with the right arm while being blindfolded.

The results were as follows:

1) Experiment 1 didn't indicate the effect of order as Lee, Magille and Weeks's indication.

2) In experiment 2 it was suggested that random order was better than blook order in practice variability. This result was similar to the results of Lee, Magille and Weeks's.

KEY WORD: *Practice Variability, Schema, Contextual Interference,*

要　約

本研究は，練習の多様性におけるスケジュールの影響を調べた。ランダムな提示順序の方がブロックされた提示順序と比べて，大人の被験者においては，学習効果が高いかを調べるために2つの実験を行った。課題は，目隠しをした大学生にキネマトメーターを使って，右腕で角度再生を行わせるというものである。

その結果，以下のようなことがわかった。

1）実験に1おいては，Lee, Magille, Weeksらと同様な順序の効果は認められなかった。

2）実験2では，練習の多様性においてランダムな順序の方がブロックされた順序よりも効果があった。この結果は，Lee, Magille, Weeksらの結果と類似するものであった。

Since the publication of Schmidt's schema theory of motor learning was proposed[5)6)], the effects of practice variability have been assessed through numerous studies. As a result, the positive effects of practice variability have been reported in these studies. However, these studies have supported that research using children as subjects show a high effect of practice variability as compared to adult subjects[4)].

Regarding this view, Lee, Magille and Weeks[3)] have suggested that one important difference in the previous studies was the influence of the structure of the practice schedule; the studies using adults as subjects that have manipulated practice variability in a blocked fashion have shown either very weak or no support to the effect of practice variability. Based upon conceptual statement by Battig regarding "contextual interference (Batting[1)]) effects" they have suggested

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to combine the effect of practice variability in adult subjects by using random ordering practice variability.

The purpose of the present investigations is to experimentally test the influence of practice schedule on practice variability with regard to the order of variability, based on Bird and Rikli[2]; random but not a blocked structuring will facilitate adult subjects compared to a blocked fashion.

Experiment 1

The purpose of experiment 1 is to test the infuluence of two present orders of practice variability. Two present orders are as follows; one is random ordering, which is not to replicate the same task, and another is block ordering (where all trials of one variation are completed before another variation of the task is practiced).

Method

Subjects

A total of thirty-six right-handed undergraduate students participated in the experiment ; there were 18 each of males and females.

Apparatus and task

The task involved using an apparatus known as a kinematometer (Takei machinery made). It consisted of a 60 ㎠×1/3 platform which displayed one degrees increments. The task was a angular recall with the right arm while being blindfolded, as well as Bird's method. The task was accomplished by extending the forearm in a clockwise direction from the starting position to the specified target location.

Procedure

During the acquisition phase, all subjects were randomly assigned to each of three condition groups, with the provision that there were equal numbers of males and females in all groups. The acquisition conditions were three. The first group was the blocked practice variability group (BVC1) which practice to replicate 15 trials at each of four locations, 40°, 50°, 70°, 80°. The second group was the randomly practice variability group (SVC1) which practiced not to replicate 15 trials at each of four locations, 40°, 50°, 70°, 80°. The third group was constant practice group (CC1) to practice at only one of those same four locations. Then, BVC1 was manipulated to remove order effect. All subjects received 60 K.R. acqiusition trials prior to transfering to a different no-K. R. location of 15 trials. During the transfer trials all subjects aimed at a new target located outside the range of acquisition trials of 90 degrees.

Results and Discussion

Acquisition trials

Observation of Figure 1 indicated nonsimilarity among three groups. However, the three

groups showed a decrease in mean absolute error with an increase of trial blocks. In SVC1, random order, the decrease of learning curve tended to be low, comparable to both BVC1 and CC1.

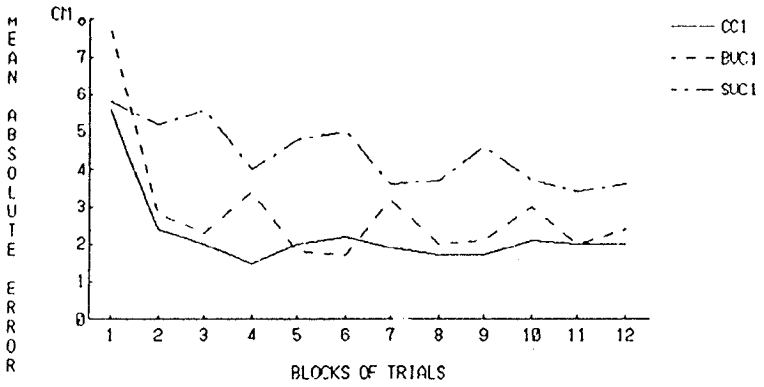

Figure 1. Effect of practice (Block/Random/Constant) during the acquisition phase (Experiment 1)

Then, acquisition data was subjected to a 3 (groups)×12 (blocks of 5 trials) variance analysis with repeated measures on the last factor. Results indicated significant main effects for both groups, $F(2,33)=26.194, (p<.001)$ and the block, $F(11,363)=18.295, (p<.001)$ factors. The interaction reached significant($F(22,363)=4.087, p<.000$). These results suggested that SVC1 performed better than both BVC1 and CC1.

Table 1. Means and Standard Deviations in Absolute Error for Condition of Practice Blocks (Block 1 and Block 12)

Condition	Block 1	Block 12
BVC1	7.7 (4.9)	2.4 (1.1) **
SVC1	5.8 (2.2)	3.6 (0.9) **
CC1	5.6 (2.3)	2.0 (0.8) **

** $p<.01$

Table 1 presented mean absolute error of both block 1 and block 12 at each of the groups. Then, to examine the learning effects, correlated t-test examined the difference between block 1 and block 12. This test indicated statistically significant differences ($p<.01$) of each of the groups. These results suggested that each group observed the learning effects in acquisition trials.

Transfer trials

Table 2. Means and Standard Deviations in Absolute Error for Blocks (Block1/Block2/Block3) of Conditions (BVC1/SVC1/CC1) on Transfer trials in Experiment 1

	Condition		
Block	BVC 1	SVC 1	CC 1
Block1	8.6 (4.4)	7.2 (4.1)	13.5 (6.7)
Block2	9.1 (3.9)	8.3 (5.2)	13.7 (5.9)
Block3	8.9 (4.8)	9.0 (5.2)	12.2 (5.1)
Average	8.9 (3.9)	8.2 (4.1)	13.4 (5.4)

Table 2 showed the results of transfer trials. In view of the results, in a recall angle CC1 in which was constant group performed poorer than both BVC1 and SVC1. And then, SVC1 which was random order performed slightly better than BVC1 which was block order with respect to two difference ordering conditions in practice variability.

Then, transfer data was subjected to a 3(groups)×3 (blocks of 5 trials) variance analysis with repeated measures on the last factor regarding mean absolute error. Result indicated significant main effect for the group, $F(2,33)=4.202$, ($p<.05$)factor. However, block factor and interaction did not reach significant. Subsequently, as a result of the scheffé's method of multiple comparision, CC1 which was constant practice performed poorer mean absolute error than both SVC1 and BVC1. These results suggested that practice variability was higher learning effect than constant practice. However, experiment 1 did not indicate the effect of order as Lee's indication.

Experiment 2

Experiment 1 did not indicate the effect of order as in Lee's indication. With respect to this matter, some causes were suggested. One was that recall angle of transfer task was 90 degrees. This was because the angle was used in daily routine. And in experiment 2, a recall angle was different from experiment 1 to remove individual differences prior to learning. To test the influence of two practice schedules, one was block order and the other was random order, on practice variability. In experiment 2 the quantity of the difference between before and after learning was examined.

Method

Subjects

A total of twenty-four right-handed undergraduate students participated in experiment

2; there were 8 males and 16 females.

Apparatus and task

The apparatus and task were the same as in experiment 1.

Procedure

Pre-trials were executed, before the acquisition phase. In the pre-trials, all subjects no-K.R. of 6 trials at 86 degrees. During the acquisition phase, all subjects were randomly assigned to each of two groups, with the provision that there were equal numbers of males and females in two groups. The acquisition conditions were two. The first group was the blocked practice variability group (BVC2) which practiced replicating 15 trials at each of four locations, 36°, 46°, 66°, and 76°. The variance in degree was 10 degrees the same as in experiment 1. The second group was the random practice variability group (SVC2) which practiced not replicating 15 trials at each of four locations, 36°, 46°, 66°, and 76°. BVC2 was manipulated to remove order effect. All subjects received 60 K.R. acquisition trials (5 trials×12 blocks at each group).

Directly after the acquisition phase, the transfer phase was executed. During the transfer trials all subjects aimed at the pre-trial target, and executed 15 trials (5 trials 3 blocks).

Results and Discussion

Pre-test trials

Table 3. Means and Standard Deviations in Absolute Error for Conditions (BVC2/SVC2) on Pre-trials in Experiment 2

	Condition	
	BVC2	SVC2
Average	26.8	25.4
S.D.	(11.6)	(14.7)

The results of pre-test trials were indicated in Table 3. In view of the results, SVC2 which practiced random order was better than BVC2 which practiced block order in mean absolute error. The difference between two blocks was not statistically significant.

Acquisition trials

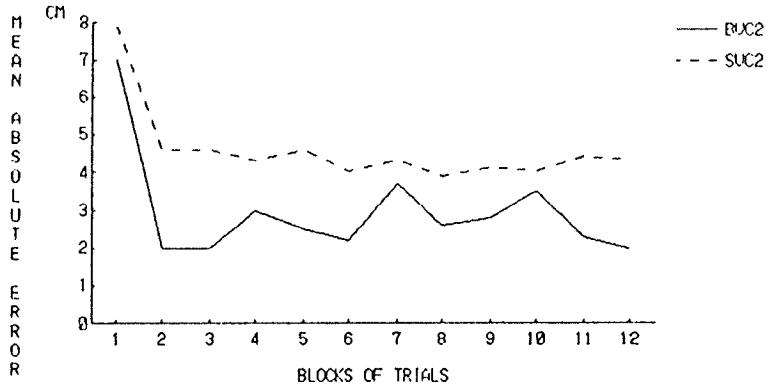

Figure 2. Effect of practice (Block/Random) during the acquisition phase (Experiment 2)

The results of acquisition trials were indicated in Figure 2. In view of the results, both groups showed a decrease in mean absolute error with an increase of trial blocks. Acquisition data was then subjected to 2 (groups)×12 (blocks of 5 trials) variance analysis with repeated measures on the last factor. These results indicated significant main effect for both groups, $F(1,22)=16.682$ ($p<.0001$) and blocks, $F(11,242)=9.955$ ($p<.001$) factors. However, the interaction did not reach significant. Subsequently, to examine the learning effect with mean absolute error, and a correlated t-test examined the difference between block 1 and block 12 in each of the groups (Table 4). This test indicated statistically significant differences ($p<.01$) in each of the groups. These results suggested that learning effects were observed in each group in the acquisition trials.

Table 4. Means Standard Deviations in Absolute Error for Condition of Practice Blocks (Block 1 and Block 12) in Experiment 2

Condition	Block1	Block 12
BVC1	7.0 (5.6)	2.0 ** (0.8)
SVC1	7.9 (3.4)	4.3 ** (1.3)

**p<.01

Transfer trials

Table 5. Means and Standard Deviations in Absolute Error for Block 1/Block 2/Block 3) of Conditions (BVC1/SVC1/CC1) on Transfer trials in Experiment 2

	Condition	
Block	BVC 1	SVC 1
Block 1	8.5 (4.0)	4.8 (1.8)
Block 2	8.8 (5.7)	6.2 (2.4)
Block 3	8.7 (6.1)	6.1 (3.3)
Average	8.8 (4.7)	5.7 (2.0)

Table 5 presented a mean absolute error in each group. These results showed that SVC2 which practiced random order did better than BVC2 which practiced blocked order. Then, transfer data was subjected to a 2 (groups)×3 (blocks of 5 trials) variance analysis with repeated measures on the last factor regarding mean absolute error. Results indicated significant trend in the groups factor, ($F(1,22)=3.935$; $p=.5711$) factor. However, the block factor and interaction did not show any significance. Then, in order to examine learning quantity in the difference between before and after practice variability in the difference of present order, transfer data was subjected to one way co-variance analysis with pre-test's block (groups). The results indicated that the group factor did not show significance, but a significant trend ($F(1,22)=3.782$; $p=.62$). As a result, it was suggested that random order was better than block order in practice variability. This result also was similar to the results of Lee, Magille and Weeks's.

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