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The Contextual Interference Effect in Learning Parameters of the Generalized Motor Program.

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THE CONTEXTUAL INTERFERENCE EFFECT
IN LEARNING PARAMETERS OF
THE GENERALIZED MOTOR PROGRAM

A Dissertation
Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in
The Department of Kinesiology

by
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Finally, a manuscript titled "The contextual interference effect with skill variations from the same and different generalized motor programs" has been published in Research Quarterly for Exercise and Sport (1994, Vol. 65, pp. 330-338). I acknowledge the permission of Research Quarterly for Exercise and Sport to include this manuscript in this dissertation. In addition, a manuscript titled "The contextual interference effect in parameter modifications of the same generalized motor program" has been resubmitted to the same journal and is currently under review for the second time. This manuscript is included in this dissertation as chapter 3. I appreciate the reviewers of the journal for their helpful comments and suggestions on the earlier draft of the manuscript.
PREFACE

This dissertation contains a series of experiments that were conducted at the Motor Behavior Laboratory in the Department of Kinesiology at Louisiana State University. Chapter 1 is a general introduction that provides an overview of research problems and rationale for the experiments presented in the subsequent chapters. Chapter 2 consists of the first two experiments that have been synthesized as one study and published in Research Quarterly for Exercise and Sport (1994, Vol. 65, pp. 330-338). Chapter 3 consists of a manuscript of the third experiment that has been submitted to the same journal and is currently under review. Chapter 4 consists of the fourth experiment that extends the findings of the first three experiments. Finally, chapter 5 is a general discussion that synthesizes the findings from the all experiments presented in this dissertation.
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ABSTRACT

Four experiments examined the generalizability of the contextual interference (CI) effect. In all experiments, to examine the locus of the CI effect measures assessing generalized motor program (GMP) learning and parameter teaming were used in addition to a measure of general performance. In the first two experiments, variations of a timing tapping task, which were controlled by either different GMPs (Experiment 1) or the same GMP (Experiment 2), were learned under either blocked (low CI) or serial (high CI) practice. The CI effect was found for the general performance measure regardless of the task characteristics, contrary to Magill and Hall’s (1990) hypothesis that tasks controlled by the same GMP do not create the CI effect. The dissociated measures of GMP learning and parameter learning showed that parameter learning was enhanced by high CI practice in both experiments and there was a tendency that GMP learning was also enhanced by high CI practice in Experiment 1. To extend the findings with timing characteristics, Experiment 3 involved task variations requiring modifications of the overall force parameter of the same GMP. Consistent with the results of Experiment 2, the results showed the CI effect for overall force parameter learning that was also reflected in the general performance. In Experiment 4, task variations requiring simultaneous modifications of both overall duration and overall force parameters of the same GMP were learned. The results showed the CI effects for both types of parameter learning, which were reflected in the general performance. Different amounts of practice used in Experiments 3 and 4 did not influence the efficacy of the CI effect. Findings based on retention and transfer tests in Experiment 4 were compatible with each other. Thus, the CI effect was found regardless of the task characteristics, the number and types of parameters modified, the amount of practice, and types of learning tests. These results indicate that the CI effect is generalizable to more various motor learning situations than previously believed because any aspect of performance that changes from trial to trial during practice leads to better retention and transfer regardless of the amount of practice.
The contextual interference (CI) effect refers to a phenomenon in which practice order of multiple tasks or task variations that may hinder acquisition performance facilitates retention and/or transfer. Typically, random practice, where tasks are practiced in an unsystematic order, leads to inferior acquisition performance but superior retention and/or transfer performance compared to blocked practice, where practice of one task is completed before practice of another task begins. The random practice is considered to create a high level of CI whereas the blocked practice is considered to create a low level of CI. The CI effect was first found in the motor domain by J. B. Shea and Morgan (1979) and it has been observed in many studies (See Chamberlin & Lee, 1993; Magill & Hall, 1990, for reviews).

Although the CI effect is a robust phenomenon in the motor learning literature, Magill and Hall (1990) have proposed that the CI effect is not found in all motor learning situations but its efficacy interacts with characteristics of tasks, subjects and experimental procedures. In terms of task characteristics, Magill and Hall proposed a hypothesis that consists of two parts. First, when task variations controlled by different generalized motor programs (GMPs) are learned, the CI effect would be found. Second, when task variations controlled by the same GMP are learned, the CI effect should not be found or a mixed schedule of blocked and random practice would lead to better learning than a pure blocked or a pure random practice schedules.

The GMP is a hypothetical notion for a memory representation that governs a class of movements (Schmidt, 1975, 1985, 1988). The GMP has invariant features, such as relative timing and relative force. The invariant features refer to compositional relationships among movement components and are the fundamental structures of the GMP. Variant features, such as overall duration and overall force, are parameters added to the GMP. Scaling of movements, such as moving faster or producing more force, can be performed by modifying the parameters without changing the fundamental GMP.
structures. When task variations share the same relative timing and relative force but have
different overall duration or overall force, they are considered to be controlled by the
same GMP. When task variations have different relative timing or relative force
characteristics, they are considered to be controlled by different GMPs. According to the
Magill and Hall (1990) hypothesis, the CI effect is unlikely to occur when task variations
controlled by the same GMP are learned.

The Magill and Hall (1990) hypothesis was based on the action plan
reconstruction hypothesis proposed by Lee and Magill (1983, 1985) to explain the CI
effect. Lee and Magill suggested that when task variations are practiced under a high
level of CI, action plans for each task variation need to be reconstructed every time they
are performed because an action plan for one task variation is forgotten due to the
intervention of performing other task variations. In contrast, when task variations are
practiced under a low level of CI, each task variation is performed repeatedly without the
performance of other task variations intervening. Thus, reconstruction of an action plan
is not necessary from trial to trial because the action plan is not forgotten from working
memory. High CI practice typically leads to acquisition performance that is inferior to
low CI practice because more effortful processing is necessary due to more frequent
action plan reconstruction. However, this repeated reconstruction process leads to better
accessibility to memory representations of learned task variations and more successful
construction of different but similar action plans. Therefore, high CI practice facilitates
learning as assessed by retention and transfer performance.

Because the action plan consists of an appropriate GMP and parameters added to
it, action plan reconstruction includes both processes of GMP construction and parameter
modifications (Magill & Hall, 1990). When task variations controlled by different GMPs
are practiced under a high CI condition, both GMP construction and parameter
modifications are required from one performance to another and a sufficient level of CI is
created to facilitate learning. On the other hand, when task variations controlled by the
same GMP are practiced under a high Cl condition, only parameter modifications are necessary from trial to trial and only minor interference is created, which is similar to that created under a low Cl condition. This insufficient level of Cl during practice leads to less effortful processing and therefore the Cl effect is unlikely to occur when task variations are controlled by the same GMP.

Although the Magill and Hall (1990) hypothesis can account for the results of many studies, some recent studies have reported the Cl effect with task variations that are considered to be controlled by the same GMP. For example, Carnahan, Van Eerd, and Allard (1990) found the Cl effect when subjects practiced variations of a timing task that required modifying the overall duration parameter of the same GMP. An experiment by C. H. Shea, Kohl, and Indermill (1990), which involved subjects learning variations of a rapid force production task that required modifications of the overall force parameter of the same GMP, revealed the Cl effect when the amount of practice was increased. The Cl effect was also found when Young, Cohen, and Husak (1993) had subjects learn variations of a rapid aiming task with similar movement patterns. In addition, the Cl effect was found when Hall, Domingues, and Cavazos (1994) had skilled baseball players practice hitting different types of pitches with very similar movements that are considered to be controlled by the same GMP.

Although these findings are inconsistent with the Magill and Hall (1990) hypothesis, indirect support for the hypothesis has been provided by many studies that failed to find the Cl effect with task variations controlled by the same GMP. For example, Heitman and Gilley (1989) and Whitehurst and Del Rey (1983) found no Cl effect when variations of a pursuit rotor task with different movement speeds were learned. Turnbull and Dickinson (1986) also failed to find the Cl effect when they had subjects learn variations of linear positioning task with different distances. In addition, Wulf (1992) had subjects practice moving a lever by hand to reproduce goal spatio-temporal movement patterns that required modifications of the overall force parameter of
the same GMP. The results of this study showed no CI effect unless frequency of knowledge of results (KR) presentation was reduced to promote a deeper level of processing.

To test the Magill and Hall (1990) hypothesis more closely, Wulf and Lee (1993) used a data analysis technique to dissociate performance measures related to parameter learning from performance measures related to GMP learning. In their experiment, subjects practiced hitting four buttons such that movement times (MTs) for each movement segment matched goal MTs for each movement segment. Because the task variations shared the same relative timing but differed in total MTs, learning these task variations required modifying the overall duration parameter of the same GMP. With the dissociation measurement technique, GMP learning was assessed based on differences between the goal relative timing and the observed relative timing, whereas parameter learning was assessed based on differences between the goal total MTs and the observed total MTs. The advantage of using the dissociation measurement technique is that it can test the rationale for the Magill and Hall hypothesis that parameter modifications do not create sufficient interference to create the CI effect. The results of this study revealed no CI effect for the measure of parameter learning in both retention and transfer, supporting the Magill and Hall hypothesis.

What is notable, however, is that none of the studies that failed to find the CI effect compared task variations controlled by the same GMP with task variations controlled by different GMPs. Failure to make this comparison allows for the possibility that the CI effect would not have occurred even if task variations from different GMPs had been learned. To attribute the difference for finding versus not finding the CI effect solely to task characteristics requires that both types of task variations be compared within a study. An experiment that took such an approach was one by Lee, Wulf and Schmidt (1992). Subjects practiced variations of a sequential tapping task that shared either the same or different relative timing structures. Although no CI effect was found in retention
regardless of the task characteristics, the transfer results revealed the CI effect only for the task variations controlled by different GMPs but not for the task variations controlled by the same GMP. Although the transfer results support the Magill and Hall (1990) hypothesis, the lack of a CI effect in retention awaits further investigation because the dissociation measurement technique was not used.

The within-study approach was also used by Hall and Magill (in press). They used variations of a tapping task which were similar to those used by Lee et al. (1992). In this study, many different types of retention and transfer tests were used. The results revealed that the CI effect was found in some of the tests regardless of the GMP characteristics of the task variations. Therefore, both types of task variations produced the CI effect, contrary to the authors’ claim that the CI effect was found only for the task variations controlled by different GMPs. An interaction between the task characteristics and practice schedules needs to be found in the analysis of test performance to conclude that the CI effect was found for one type of task but not for the other. However, because this interaction was not evident for all CI effects found in this study, the results of this study contradicted the Magill and Hall (1990) hypothesis. In addition, because the dissociation measurement technique was not used in this study, it was unknown whether GMP learning or parameter learning produced the CI effect.

To summarize, published evidence exists that both supports and contradicts the Magill and Hall (1990) hypothesis, indicating the questionable status of the validity of this hypothesis. Thus, it is necessary to further examine this hypothesis by using a methodology that leads to more direct evidence that supports or denies the hypothesis. One way to do this is to combine the experimental procedures used by Lee et al. (1992) and Wulf and Lee (1993). As was done by Lee et al., the within-study approach, in which both same and different GMP task variations are practiced in either a high or low CI condition, should be used to ensure that a lack of the CI effect for one type of task can be solely attributed to the task characteristics. Also, as was done by Wulf and Lee, the
dissociation measurement approach, in which measures of GMP learning are dissociated from measures of parameter learning, should be used to directly examine the rationale for the hypothesis.

Therefore, the first purpose of this dissertation was to directly examine the Magill and Hall (1990) hypothesis by using both within-study and dissociation measurement approaches. This issue was addressed in the first two experiments (Sekiya, Magill, Sidaway & Anderson, 1994) presented in Chapter 2. In both experiments, variations of a timing tapping task that were similar to those used by Lee et al. (1992) and Wulf and Schmidt (1993) were practiced in either a serial (high Cl) or blocked (low Cl) condition.

The results of Experiment 1 revealed the Cl effect for the general performance measure for learning task variations from different GMPs. However, the dissociated measures showed that the Cl effect was found only for parameter learning though a tendency toward an predicted Cl effect was also observed for GMP learning. The results of Experiment 2 showed that contrary to the Magill and Hall (1990) hypothesis the Cl effect was found for the general performance measure for learning task variations from the same GMP. The dissociated measures showed that the Cl effect occurred only for parameter learning but not for GMP learning.

The second purpose of this dissertation relates to a question that remains from the results of Experiment 2. That is, if the Cl effect can be found for learning task variations requiring overall duration parameter modifications, can this finding be applied to other parameters of the GMP, such as the overall force parameter? Although subjects in Experiment 2 could have modified both overall duration and overall force parameters at the same time to produce the goal timing, because only timing components of the task were measured and analyzed, it was unknown if the subjects modified the overall force parameter of the GMP. It was therefore necessary to examine if modifications of the overall force parameter of the same GMP can produce the Cl effect in order to examine the generalizability of the findings with timing characteristics to findings with force
characteristics. Therefore, Experiment 3 of this dissertation was designed to examine if modifications of the overall force parameter of the same GMP can create the CI effect.

The third purpose of this dissertation was related to the influence of the amount of practice on the CI effect, because there have been inconsistent findings about this issue. Although C. H. Shea et al. (1990) found that the CI effect was more likely to be found with an increased amount of practice, Proteau, Blandin, Alain and Dorion (1994) found the CI effect equally well after three different amounts of practice. However, there was a discrepancy in task characteristics used in these studies. C. H. Shea et al. used task variations controlled by the same GMP, whereas Proteau et al. used task variations controlled by different GMPs. This difference in task characteristics suggests that the CI effect with task variations controlled by the same GMP might interact with the amount of practice, whereas the CI effect with task variations controlled by different GMPs is unlikely to be influenced by the amount of practice.

However, only one study (C. H. Shea et al., 1990) has demonstrated the interaction between the amount of practice and the efficacy of the CI effect when task variations were controlled by the same GMP. It was necessary to examine reliability of this finding by further examining the influence of the amount of practice on the CI effect. Furthermore, if the CI effect with task variations controlled by the same GMP interacts with the amount of practice, this interaction is consistent with the Magill and Hall (1990) hypothesis because it predicts that the CI effect for task variations from the same GMP is less likely to be found compared to the CI effect for task variations from different GMPs.

This amount of practice issue was also addressed in Experiment 3 (Sekiya, Magill and Anderson, 1995), which is presented in Chapter 3. In this experiment, subjects learned to move a computer mouse along a linear track to reproduce three goal movement patterns, each of which had three movement segments. Because the patterns shared the same relative amplitude but had different overall amplitudes, subjects were required to produce different amounts of force but with the same relative amount of force. Timing
characteristics, such as relative timing and overall duration, were identical for all patterns. Retention tests were administered after 270 and 540 acquisition trials. The results of Experiment 3 revealed a clear CI effect in the measure of the general performance after both amounts of practice, which was attributed to overall force parameter learning. Consistent with the results of Experiment 2, no CI effect was found for GMP learning. Therefore, it was concluded that modifications of the overall force parameter produced the CI effect contrary to the prediction of the Magill and Hall (1990) hypothesis. Also, contrary to the findings by C. H. Shea et al., the CI effect was demonstrated equally well after two different amounts of practice.

Although no interaction between the amount of practice and the efficacy of the CI effect was found in Experiment 3, it is possible that this experiment did not adequately test the amount of practice hypothesis. When the previous studies that used task variations controlled by the same GMP were reviewed in the light of the amount of practice, it was likely to find the CI effect when the number of acquisition trials exceeded 200 (Experiments 2 & 3 of this dissertation), whereas it was unlikely to find the CI effect when the number of acquisition trials was less than 150 (Heitman & Gilley, 1989; Turnbull & Dickinson, 1986; Whitehurst & Del Rey, 1983; Wulf, 1992). When the number of trials was between 150 and 200, inconsistent findings have been reported (Hall & Magill, in press; Lee et al., 1992; Young et al., 1993). Thus, it is possible that the amount of practice used in Experiment 3 may not have been adequate to test the hypothesis. Support for this possibility can be seen in the findings from an within-study comparison by C. H. Shea et al. (1990). No CI effect was found after 50 acquisition trials, whereas a clear CI effect was found after 400 acquisition trials. After 200 acquisition trials, a somewhat moderate CI effect was found as high CI practice led to better retention performance than low CI practice only under one of two retention test conditions.
Because the numbers of acquisition trials used in Experiment 3 (i.e., 270 and 540) were relatively large, it was necessary to further examine the influence of the amount of practice on the CI effect by including a relatively small number of acquisition trials. Therefore, the influence of the amount of practice on the CI effect was again pursued in Experiment 4 presented in Chapter 4.

The fourth purpose of this dissertation was to reexamine the CI effect in retention and transfer within an experiment. Discrepancies between retention and transfer findings have been reported when the dissociation measurement technique has been used. The retention results of Experiments 2 and 3 showed that high CI practice of task variations controlled by the same GMP enhanced parameter learning but not GMP learning. However, transfer results reported by Wulf and Lee (1993) showed that high CI practice enhanced GMP learning but hindered parameter learning. They concluded that because the detrimental effect of high CI practice on parameter learning cancels out the beneficial effect of high CI practice on GMP learning, no CI effect is found in the measure of general performance when task variations controlled by the same GMP are learned. In Experiment 4, both retention and transfer tests were used to clarify the inconsistent findings between these two types of learning tests.

Finally, although the CI effect was found for measures of the overall duration and overall force parameters in Experiments 2 and 3, respectively, it was still unknown whether simultaneous modifications of both parameters could produce the CI effect in the measures of both types of parameter learning. According to Magill and Hall (1990), requiring subjects to modify more than one parameter might establish sufficient interference to produce the CI effect. Even though modifications of the overall duration parameter were shown to create the CI effect, subjects could have modified both timing and force parameters at the same time. Because only timing components of the task were measured in Experiment 2, it was not possible to determine if both overall duration and overall force parameters were modified and, if both of these components contributed to
the CI effect found for the general performance measure. Because it is not unusual to
simultaneously modify more than one parameter in real world motor learning situations, it
was necessary to investigate the CI effect with modifications of both overall duration and
overall force parameters of the GMP. Therefore, the fifth purpose of this dissertation
was to examine if simultaneous modifications of both parameters of the same GMP could
create the CI effect. If the CI effect was found for the general performance measure, it
was necessary to further examine whether the CI effect was attributed to both types of
parameter learning. This issue was also addressed in Experiment 4 in Chapter 4.

Experiment 4 not only addressed the question of simultaneous parameter
modifications, but also provided a way to again investigate the previously considered
issues related to the effect of the amount of practice and the retention versus transfer tests
effects. In this experiment, subjects in both blocked and serial acquisition conditions had
60, 120 and 180 acquisition trials on the first, second and third days of the experiment,
respectively. Thus, total numbers of acquisition trials after each acquisition session were
60, 180 and 360. Based on the review of the previous studies, it was predicted that the
efficacy of the CI effect would increase as the amount of practice increased. One day
after each acquisition session, 15 retention test trials was performed without KR followed
by 15 transfer test trials without KR. If the findings from the retention test in
Experiments 2 and 3 were generalizable to transfer performance, parameter learning but
not GMP learning should be responsible for the CI effect in transfer. Finally, task
variations that required modifications of both overall duration and overall force
parameters were used and both timing and force components were measured. Based on
the findings from Experiments 2 and 3, it was predicted that the CI effect found for the
general performance measure would be attributed to the CI effect found for the measures
of both overall duration and overall force parameters.

In summary, this dissertation presents a series of four experiments designed to
systematically test the generalizability of the CI effect as proposed by the Magill and Hall
hypothesis concerning the differential effect of task variation characteristics. Experiments 1 and 2 examined the CI effect for task variations involving timing characteristics controlled by the same and different GMPs. Experiment 3 extended Experiment 2 by investigating force characteristics. The influence of the amount of practice on the CI effect was examined in both Experiments 3 and 4. Experiment 4 also addressed the issues about compatibility of retention and transfer findings and the CI effect with simultaneous modifications of both overall duration and overall force parameters of the same GMP. Taken together, the results from this series of experiments modifies and extends the knowledge about the generalizability of the CI effect with regard to task, parameter, practice amount and test characteristics. The dissociation measurement approach would also provide theoretical implications about the locus of the CI effect in terms of GMP and parameter learning.

References for Chapter 1


CHAPTER 2: EXPERIMENTS 1 AND 2*

Introduction

The contextual interference (CI) effect refers to a phenomenon whereby interference during acquisition may hinder acquisition performance but facilitate learning as assessed by retention and/or transfer performance. Many studies have demonstrated that task variations which were practiced in a high CI condition (e.g., random order) produced inferior acquisition performance, but superior retention and/or transfer performance compared to task variations which were practiced in a low CI condition (e.g., blocked order) (see Magill & Hall, 1990). After their extensive review of the CI literature, however, Magill and Hall concluded that the CI effect is not found in all learning situations where multiple task variations are to be learned. Rather, they proposed that the CI effect interacts with task characteristics, and hypothesized that the CI effect would be found when task variations to be learned are governed by different generalized motor programs (GMPs), but would not be found when task variations are governed by the same GMP.

Magill and Hall's (1990) view of the GMP was based on the one popularized by Schmidt (1975, 1985, 1988), wherein the GMP is a memory representation for a class of movements. When features such as relative timing and relative force remain invariant, movements are considered to be in the same class and governed by the same GMP. Features which are free to vary from one performance to another, such as overall movement duration and overall force, are viewed as parameters of the GMP. Under this conceptualization, task variations that have different relative timing or relative force structures are controlled by different GMPs, whereas task variations that share the same invariant features, but vary in terms of parameters, are controlled by the same GMP.

According to Magill and Hall (1990), parameter modifications of the same GMP do not create sufficient interference to require the additional processing during acquisition that facilitates retention and/or transfer performance. This prediction is based on an action plan reconstruction view proposed by Lee and Magill (1983, 1985) to explain the Cl effect. Lee and Magill (1983, 1985) suggested that action plans for movements must be reconstructed when multiple tasks are practiced under high Cl conditions, and thus stronger representations of the movements are stored because action plan reconstruction leads to more effortful information processing. The action plan consists of an appropriate GMP and the parameters that are added to it (Magill & Hall, 1990), indicating that action plan reconstruction includes both processes related to GMP construction and parameter modifications. Therefore, under high Cl conditions, practice of task variations that are controlled by the same GMP requires only parameter modifications of the GMP and leads to less effortful processing. In contrast, when task variations controlled by different GMPs are practiced under high Cl conditions, both GMP construction and parameter modifications are involved, leading to more effortful processing.

Although Magill and Hall's (1990) hypothesis can account for the results of many studies, some recent studies have demonstrated the Cl effect for task variations controlled by the same GMP (Shea, Kohl, & Indermill, 1990; Wulf, 1992; Wulf & Lee, 1993; Young, Cohen, & Husak, 1993). Additionally, Lee, Wulf, and Schmidt (1992) reported a Cl effect for transfer only when task variations controlled by different GMPs were learned. However, no Cl effect was found for retention regardless of the characteristics of the task variations. Clearly, more research is needed to examine the validity of the hypothesis with respect to retention performance.

Although Magill and Hall (1990) attributed the Cl effect to the degree of action plan construction, they did not explicitly state whether GMP construction or parameter modifications contribute to the effect. Based on their theoretical rationale, however, it is possible to derive the following predictions. First, when task variations are controlled by
different GMPs, the CI effect occurs in both GMP learning and parameter learning. When the GMPs are reconstructed, parameters added to them also need to be modified. Thus, the CI effect in GMP construction leads to the CI effect in parameter modifications. Secondly, when task variations are controlled by the same GMP, the CI effect does not occur in either GMP learning or parameter learning, because modifying the parameters without reconstructing the GMP does not produce sufficient interference.

In order to test these predictions it is necessary to dissociate parameter learning from GMP learning in terms of the dependent variables, because whether the CI effect can be found as a result of GMP construction or parameter modifications has rarely been investigated. One exception is a recent study by Wulf and Lee (1993) in which they dissociated GMP learning from parameter learning by independently measuring the accuracy of the GMP and the accuracy of parameter modifications. This measurement approach allowed the authors to examine which type of learning was enhanced by high CI practice.

In this study, Wulf and Lee (1993) investigated skill variations from the same GMP. Their results showed that GMP learning, but not parameter learning, was enhanced by high CI practice when learning was assessed in a transfer test, contrary to the second prediction derived from the Magill and Hall (1990) hypothesis. However, no CI effect was found in either GMP learning or parameter learning when learning was assessed by retention performance, contrary to the claim in their discussion of results. Although this finding seems to be consistent with the second prediction, a lack of the CI effect in both GMP construction and parameter modifications during retention cannot be directly attributed to task characteristics. Because Wulf and Lee (1993) did not use skill variations controlled by different GMPs in comparison to skill variations controlled by the same GMP, it is possible that the CI effect in retention did not occur even if skill variations controlled by different GMPs were learned. Therefore, the CI effect in retention awaits further research. Furthermore, the dissociation measurement approach
has yet to be applied to the CI effect in retention when task variations controlled by
different GMPs are learned in order to test the first prediction derived from the Magill and
Hall (1990) hypothesis.

Thus, the main purpose of the present research was to examine the Magill and
Hall (1990) hypothesis for retention performance in a three-segment timing/tapping task
in which task variations are controlled by the same and different GMPs. In Experiment
1, task variations had different relative timing structures, while in Experiment 2, task
variations shared the same relative timing structure but varied in overall movement time
(MT). In both experiments, the task variations were practiced in either a blocked (low
CI) or a serial (high CI) condition. The serial order, instead of a random order, was used
in the present study so that a reverse serial retention condition might provide a common
novel retention test condition for both acquisition groups along with more traditional
blocked and serial retention conditions. In data analyses, parameter learning was
dissociated from GMP learning through separate measurements to examine which
learning is enhanced by high CI in acquisition. The accuracy of the GMP was measured
by calculating the proportional relationship between MTs for the three segments. The
accuracy of parameter modifications was assessed by performance on the overall duration
of the movement and was measured as a total MT. Based on Magill and Hall's
hypothesis, the serial acquisition group should have retention performance superior to
that of the blocked acquisition group in both GMP and parameter measures in Experiment
1, whereas both acquisition groups should perform equally in both measures, suggesting
no CI effects, in Experiment 2.

Experiment 1

In this experiment, the CI effect on retention was investigated for learning task
variations having different relative timing structures. These variations are hypothesized to
be controlled by different GMPs.
Method

Subjects

Thirty-six university students (18 males with mean age = 22.3 years, $\text{SD} = 2.6$ years and 18 females with mean age = 23.7 years, $\text{SD} = 6.2$ years) volunteered as subjects. None had prior experience with the task, and all were naive to the purpose of the experiment. Informed consent was obtained from all subjects.

Apparatus and Task

The apparatus was modeled after that used by Wulf and Schmidt (1988). It consisted of a wooden board and four response buttons (2.5 cm in diameter). The response buttons, placed 18 cm apart in a diamond pattern, were attached to four microswitches that were interfaced with an IBM PS/2 computer. The subject sat at a table with the board placed on the table so that response buttons 1 and 3 were perpendicular to the subject's frontal plane, and response buttons 2 and 4 were parallel with the subject's frontal plane.

The response buttons were hit in a clockwise direction with the dominant hand. Hitting the buttons in sequence resulted in three movement segments. Performance was assessed by the MT for each segment, designated as MT1, MT2, and MT3. Subjects were asked to hit the response buttons such that the MTs were as close to the goal MTs as possible. Subjects practiced three task variations, representing fast, medium and slow speeds. Each variation had a different relative timing and a different overall duration. The goal MTs for each segment (MT1-MT2-MT3) were 300-225-150 ms, 300-200-400 ms, and 250-500-375 ms, for the fast, medium, and slow speed variations, respectively. The proportions of the goal MTs (MT1-MT2-MT3) with respect to the overall durations (sum of the goal MTs) for the fast, medium, and slow speed variations were 44.4-33.3-22.2%, 33.3-22.2-44.4% and 22.2-44.4-33.3%, respectively.
**Experimental Groups and Procedures**

The subjects were randomly assigned to either a blocked or a serial acquisition condition, such that each condition had an equal number of subjects (n=18) and each contained an equal number of males and females (n=9). All subjects performed a total of 270 acquisition trials (90 trials on each task variation). This relatively large number of trials was chosen because Shea et al. (1990) have shown that the efficacy of the CI effect improved as the number of acquisition trials increased. The subjects were asked to start the movement after the goal MTs were displayed on the computer screen. The resulting MTs for each segment were displayed along with the corresponding goal MTs, as knowledge of results (KR) 1 s after response button 4 was hit. KR was displayed for 5 s, which was a part of an inter-trial interval of 12 s. A 1-min rest was provided after every 90 trials.

Subjects in the blocked acquisition condition completed 90 trials on one task variation before the next task variation was introduced. The subjects in the serial acquisition condition performed the 270 acquisition trials in 90 identical triplets. Each triplet contained the three task variations. For both acquisition conditions, the order in which the task variations were performed was counterbalanced across the subjects in a Latin square design.

One day after the acquisition trials were completed, all subjects performed 30 retention trials (10 trials on each task variation) without KR. Subjects in each acquisition condition were randomly assigned to one of three retention conditions, which were a blocked, a serial, and a reverse serial retention conditions. Each pair of acquisition-retention conditions contained an equal number of the subjects (n=6) and contained an equal number of males and females (n=3). The subjects in the blocked retention condition completed 3 blocks of 10 trials in the same order as in acquisition. The subjects in the serial retention condition performed the 30 trials in 10 triplets of 3 trials, in an identical order to that used in acquisition. The subjects in the reverse serial retention
condition performed the 30 trials in 10 triplets of 3 trials, in a reversed order to that used in acquisition.

**Dependent Measures and Statistical Analyses**

Although constant error (CE), which reflects response bias, variable error (VE), which reflects response consistency, and total variability (E)\(^1\), which reflects both, were calculated, only the results of E are reported in this paper, because the results of CE and VE showed similar tendencies to E in all aspects. E was calculated for three aspects of performance, yielding three dependent measures. These were based on measures derived by Wulf and Schmidt (1988) and Wulf and Lee (1993) to measure GMP and parameter learning characteristics. Global timing performance, E\(_{GT}\), was used to assess both the accuracy of the GMP and the accuracy of the parameter modifications. Relative timing performance, E\(_{RT}\), was used to assess the proportional accuracy of the GMP. Overall duration performance, E\(_{OD}\), was used to assess the accuracy of the parameter modifications.

Global timing performance, E\(_{GT}\), was derived by calculating E for the differences between the goal MTs and the observed MTs for each segment of each task variation. Although E\(_{GT}\) did not dissociate parameter modifications from GMP construction, this measurement was reported for two reasons. Firstly, the subject's task was to reduce errors with respect to this measurement. Secondly, only general error measurements of this kind have been reported in the majority of previous studies on the CI effect. Relative timing performance, E\(_{RT}\), was derived by calculating E for the differences between the goal MT proportions and the observed MT proportions for each segment of each task variation. Overall duration performance, E\(_{OD}\), was derived by calculating E for the differences between the goal total MT (sum of the goal MTs for each segment) and the observed total MT (sum of the observed MTs). E\(_{GT}\), E\(_{RT}\) and E\(_{OD}\) were calculated for each block of 10 trials, resulting in 9 acquisition trial blocks and 1 retention trial block.\(^2\)
For both acquisition and retention performance, \( E(GT) \), \( E(RT) \) were averaged over the movement segments and the task variations, and \( E(OD) \) was averaged over the task variations. For acquisition performance, the dependent measures were then analyzed separately by \( 2 \times 9 \) (Acquisition Condition \( \times \) Trial Block) ANOVAs with repeated measures on the last factor. For retention performance, the dependent measures were analyzed separately by \( 2 \times 3 \) (Acquisition Condition \( \times \) Retention Condition) ANOVAs. For the repeated measures, degrees of freedom were adjusted whenever the sphericity assumption was violated according to examination of the Greenhouse-Geisser epsilon values. All post hoc analyses were done with the Tukey's honestly significant difference (HSD) test. To prevent an increased Type I error rate, a Bonferroni procedure was applied to both acquisition and retention data. Thus, the rejection region was \( p < .017 \) in all analyses.

Results

Global Timing Performance

**Acquisition.** The analysis of global timing performance, \( E(GT) \), showed significant main effects for Acquisition Condition, \( F(1, 34) = 12.28, p < .001 \), and Trial Block, \( F(4.3, 146.3) = 31.10, p < .001 \). The effect size for the Acquisition Condition main effect was .84. As shown in Figure 2.1, both acquisition groups showed improvement in global timing performance during practice, but the blocked acquisition group (\( M = 77 \) ms, \( SD = 24 \) ms) demonstrated performance superior to the serial acquisition group (\( M = 99 \) ms, \( SD = 28 \) ms) throughout the acquisition trials. No interactions were significant.

**Retention.** The ANOVA showed a significant main effect only for Acquisition Condition, \( F(1, 30) = 7.13, p < .017 \), and the effect size for this main effect was .80. As shown in Figure 2.1, the serial acquisition group (\( M = 85 \) ms, \( SD = 17 \) ms) demonstrated global timing performance superior to the blocked acquisition group (\( M = 112 \) ms, \( SD = 44 \) ms) in retention.
Figure 2.1. Mean total variability of global timing performance, $E(GT)$, during acquisition and retention in Experiment 1. Each data point was calculated from 10 trials, and averaged over the movement segments, task variations, subjects and retention conditions.
Relative Timing Performance

**Acquisition.** The analysis of relative timing performance, E(RT), showed significant main effects for Acquisition Condition, $E(1, 34) = 8.30, p < .01$, and Trial Block, $E(5.2, 177.6) = 30.62, p < .001$. The effect size for the Acquisition Condition main effect was .72. As shown in Figure 2.2, both acquisition groups showed improvement in relative timing performance, but the blocked acquisition group ($M = 6.9\%, SD = 2.0\%$) demonstrated more accurate performance than the serial acquisition group ($M = 8.3\%, SD = 1.9\%$) throughout acquisition. There were no significant interaction effects.

**Retention.** Although the serial acquisition group ($M = 7.7\%, SD = 1.6\%$) showed relative timing performance superior to the blocked acquisition group ($M = 8.3\%, SD = 1.8\%$) with an effect size of .35, the ANOVA showed neither significant main effects nor interactions.

Overall Duration Performance

**Acquisition.** The analysis of overall duration performance, E(OD), showed significant main effects for Acquisition Condition, $E(1, 34) = 13.60, p < .001$, and Trial Block, $E(4.2, 143.1) = 18.54, p < .001$. As shown in Figure 2.3, the blocked acquisition group ($M = 131 ms, SD = 52 ms$) demonstrated overall duration performance superior to the serial acquisition group ($M = 183 ms, SD = 73 ms$) throughout practice, though both groups showed improvement. The effect size for the group difference was .81.

**Retention.** The ANOVA showed a significant main effect only for Acquisition Condition, $E(1, 30) = 6.74, p < .017$, with an effect size of .82. As shown in Figure 2.3, the serial acquisition group ($M = 140 ms, SD = 53 ms$) demonstrated more accurate overall duration performance than the blocked acquisition group ($M = 226 ms, SD = 138 ms$) in retention.
Figure 2.2. Mean total variability of relative timing performance, E(RT), during acquisition and retention in Experiment 1. Each data point was calculated from 10 trials, and averaged over the movement segments, task variations, subjects and retention conditions.
Figure 2.3. Mean total variability of overall duration performance, $E(OD)$, during acquisition and retention in Experiment 1. Each data point was calculated from 10 trials, and averaged over the task variations, subjects and retention conditions.
Discussion

The results support Magill and Hall’s (1990) hypothesis that the Cl effect can be found with task variations controlled by different GMPs. Global timing performance, which reflected the accuracy of both the GMP and parameter modifications, showed a clear Cl effect. The serial order in acquisition created a high level of Cl that resulted in performance inferior to the blocked order. In contrast, retention performance was better for the serial group than for the blocked group.

One notable characteristic of these results is that they differ from Lee et al.'s (1992) results in which a similar timing task showed no Cl effect in retention. One possible reason for these incompatible findings in retention is that Lee et al. used less acquisition trials (90 trials) than in the present experiment (270 trials). Support for this contention is provided by the results from an experiment by Shea et al. (1990) which showed that the amount of practice can be a factor influencing the efficacy of the CI effect on retention.

Although the Cl effect was found for global timing performance, it is not possible to determine from this performance measure whether the Cl effect occurred in GMP learning or in parameter learning. This is because global timing performance reflects the combined results of both the accuracy of the GMP and the accuracy of the parameter modifications. Therefore, to dissociate performance related to the GMP from performance related to the parameter modifications, relative timing performance, which reflected the accuracy of the GMP, and overall duration performance, which reflected the accuracy of the parameter modifications, were analyzed separately.

For relative timing performance, the predicted influence of Cl was seen during acquisition. In retention, although there was a tendency toward the predicted Cl effect, the serial acquisition group did not statistically differ from the blocked acquisition group. Because Chamberlin and Lee (1993) argued that retention performance is more important than acquisition performance when the Cl effect is examined, the results of the present
experiment do not provide sufficient evidence to conclude that the CI effect is created in GMP learning when skill variations are controlled by different GMPs.

Analysis of the overall duration performance showed a marked CI effect, indicating that the CI effect occurred in parameter learning. This finding is consistent with the study by Gabriele, Hall, and Buckolz (1987) in which learning overall durations of different multi-segment movement patterns led to a CI effect in retention. Therefore, analyses of the two distinct measures indicated that parameter learning is enhanced by high CI practice when skill variations are from different GMPs.

Although the results of the present experiment provided support for one part of the Magill and Hall hypothesis by demonstrating the CI effect with task variations controlled by different GMPs, the second part of the hypothesis, that the CI effect should not be found with task variations controlled by the same GMP, remains to be examined. The following experiment was therefore designed to examine whether only parameter modifications, without GMP construction, can create sufficient interference during acquisition to subsequently facilitate retention.

Experiment 2

Method

Subjects

Thirty-six university students (18 males with mean age = 25.2 years, SD = 5.1 years and 18 females with mean age = 23.1 years, SD = 5.0 years) volunteered as subjects. None had prior experience with the task and none participated in Experiment 1. Subjects were naive to the purpose of the experiment. Informed consent was obtained from all subjects.

Apparatus, Task, Experimental Groups, Procedures, Dependent Measures, and Statistical Analyses

The apparatus, task, experimental groups, procedures, dependent measures and statistical analyses were identical to those used in Experiment 1 except for the goal MTs of the task variations. In Experiment 2, the three task variations shared the same relative
timing but had different overall durations. The absolute goal MTs (MT1-MT2-MT3) for the fast, medium and slow-speed task variations were 225-150-300 ms, 300-200-400 ms and 375-250-500 ms, respectively. The proportion of the goal MTs (MT1-MT2-MT3) with respect to the overall duration was 33.3-22.2-44.4% for all task variations.

For acquisition performance, the dependent measures were separately analyzed by 2 x 9 (Acquisition Condition x Trial Block) ANOVAs with repeated measures on the last factor, while 2 x 3 (Acquisition Condition x Retention Condition) ANOVAs were used for retention performance.

Results

Global Timing Performance

Acquisition. The analysis of global timing performance, E(GT), showed a significant main effect only for Trial Block, E (4.2, 143.1) = 24.56, p < .001. As shown in Figure 2.4, global timing performance improved for both acquisition groups.

Retention. The ANOVA showed a significant main effect only for Acquisition Condition, E (1.30) = 8.56, p < .01, with an effect size of 1.00. As shown in Figure 2.4, the serial acquisition group (M = 72 ms, SD = 18 ms) demonstrated superior performance to the blocked acquisition group (M = 99 ms, SD = 35 ms) in retention.

Relative Timing Performance

Acquisition. The analysis of relative timing performance, E(RT), showed a significant main effect only for Trial Block, E (5.7, 193.4) = 19.75, p < .001. As shown in Figure 2.5, both acquisition groups showed improvement in relative timing performance.

Retention. The ANOVA showed no significant main effects or interactions. As shown in Figure 2.5, acquisition groups did not differ in relative timing performance during retention.
Figure 2.4. Mean total variability of global timing performance, E(GT), during acquisition and retention in Experiment 2. Each data point was calculated from 10 trials, and averaged over the movement segments, task variations, subjects and retention conditions.
Figure 2.5: Mean total variability of relative timing performance, E(RT), during acquisition and retention in Experiment 2. Each data point was calculated from 10 trials, and averaged over the movement segments, task variations, subjects and retention conditions.
**Overall Duration Performance**

**Acquisition.** The analysis of overall duration performance, $E(OD)$, showed significant main effects for Acquisition Condition, $F(1, 34) = 6.58, p < .017$, and Trial Block, $F(3.8, 130.3) = 19.19, p < .001$. As shown in Figure 2. 6, both acquisition groups improved in overall duration performance, but the blocked acquisition group ($M = 141$ ms, $SD = 64$ ms) demonstrated performance superior to the serial acquisition group ($M = 178$ ms, $SD = 61$ ms) throughout acquisition. The effect size for the group difference was .59. There were no significant interaction effects.

**Retention.** The ANOVA showed a significant main effect only for Acquisition Condition, $F(1, 30) = 8.76, p < .01$, with an effect size of .97. As shown in Figure 2. 6, the serial acquisition group ($M = 153$ ms, $SD = 53$ ms) demonstrated performance superior to the blocked acquisition group ($M = 236$ ms, $SD = 110$ ms), indicating a CI effect.

**Discussion**

Experiment 2 examined whether practicing task variations controlled by the same GMP could produce the CI effect. The second part of the Magill and Hall (1990) hypothesis indicates that because such task variations require only parameter modifications of the GMP, they do not create sufficient interference during practice to subsequently facilitate retention. According to this hypothesis, no CI effect would be expected for any of the dependent variables used in this experiment. Results, however, indicated that there was no CI effect only for relative timing performance. Thus, in support of Magill and Hall's idea, different levels of CI during acquisition did not differentiate processing activities related to GMP construction, as learning skill variations within the same class does not require GMP reconstruction.

In contrast to the finding for relative timing performance, overall duration performance clearly demonstrated the CI effect. During acquisition, high CI caused by modifications of the overall duration parameter led to inferior performance compared to
Figure 2. Mean total variability of overall duration performance, E(OD), during acquisition and retention in Experiment 2. Each data point was calculated from 10 trials, and averaged over the task variations, subjects and retention conditions.
performance associated with a low level of CI. This negative effect in acquisition subsequently became a beneficial effect for retention performance.

This finding contradicts the results of Wulf and Lee's (1993) study in which the accuracy of parameter modifications showed no CI effect or a slight disadvantage for a high CI acquisition group during retention. These incompatible findings on retention may be due to differences in the amount of practice used in the two studies, given that Shea et al. (1990) have already demonstrated that the influence of high and low CI acquisition conditions on retention can be inverted by increasing the amount of practice. The present study used a larger number of acquisition trials (270 trials) than used in Wulf and Lee's (1993) study (108 trials). Although Wulf and Lee's (1993) finding provides support for the hypothesis of Magill and Hall that the CI effect cannot be attributed to the process of parameter modification, the present finding clearly contradicts it. In the present research, modifications of the overall duration parameter created sufficient CI to degrade acquisition performance and facilitate retention.

Although global timing performance showed the CI effect, what was observed for this measure becomes clear when the results of relative timing performance and overall duration performance are considered together. Global timing performance, which is sensitive to the accuracy of both GMP construction and parameter modifications, reflected the CI effect found for overall duration performance. This result suggests that when skill variations of the same class are to be learned, the CI effect can be attributed in some degree to parameter modifications.

General Discussion

The purpose of the present research was to examine the hypothesis proposed by Magill and Hall (1990) that the CI effect would be found when task variations are controlled by different GMPs but not when the task variations involve parameter modifications of the same GMP. Two predictions were examined. First, when task variations are governed by different GMPs, the CI effect should occur in both GMP
learning and parameter learning. Second, when variations are governed by the same GMP, the CI effect should not occur in either GMP or parameter learning. Two experiments were designed in which the analyses included dependent measures that dissociated parameter learning from GMP learning by independently measuring overall duration performance and relative timing performance.

When task variations were controlled by different GMPs, the results of Experiment 1 provided support for part of the first prediction in that the CI effect was found for parameter learning. However, the second part of the prediction, that the CI effect would be found for GMP learning, was not supported. When task variations were controlled by the same GMP, the results of Experiment 2 provided support for part of the second prediction in that the CI effect was not found for GMP learning. However, the second part of the prediction was clearly not supported because the CI effect was found for parameter learning. Contrary to Magill and Hall’s notion, parameter modifications alone did produce sufficient interference to create the CI effect.

The most significant outcome of the present study is to suggest that the Magill and Hall hypothesis needs to be modified by taking into account the processes of GMP construction and parameter modification. A more appropriate hypothesis may be that a CI effect will be found in parameter learning, but not in GMP learning, regardless of whether skill variations are controlled by the same or different GMPs. Because the present research focused only on the CI effect for retention performance, this new hypothesis should be restricted to the retention aspect of skill learning.

The present findings clearly conflict with those reported by Wulf and Lee (1993) where they dissociated effects on GMP learning and parameter learning. They found that high CI acquisition had an advantage for GMP learning but a disadvantage for parameter learning. They then concluded that the CI effect is not usually found in general performance measures because these differential effects cancel out. This incompatibility between retention findings in the present study and transfer findings in Wulf and Lee’s
(1993) study awaits further investigation, because whether retention and transfer tests reflect the same underlying processing of skill learning is still undetermined (Magill & Hall, 1990).

Another restriction for the modified hypothesis concerns the amount of practice, because the discrepancies between the results of the present study and the results of the previous studies (Lee et al., 1992; Wulf & Lee, 1993) may be due to the differences in the number of acquisition trials. As Shea et al. (1990) have demonstrated, the amount of practice can be a crucial factor that can even invert the effects of practice conditions on retention. Additionally, if a greater number of acquisition trials had been used in the present research, a Cl effect might have been observed in GMP learning when skill variations are controlled by different GMPs because the results showed a tendency toward the predicted Cl effect. Further research is necessary to examine the influence of amount of practice on the Cl effect.

Finally, the modification of the hypothesis should be restricted to the Cl effect associated with the overall duration parameter because the present study did not include other parameters such as an overall force parameter. In addition, Magill and Hall (1990) proposed their idea in terms of modifications of two or more parameters. Based on the reconstruction hypothesis (Lee & Magill, 1983, 1985), they argued that modifications of two or more parameters should create a stronger Cl effect compared to modifications of only one parameter. The results of the present study support this prediction because the Cl effect created by multiple parameters would be reflected more in general error measurements. Clearly, further research is necessary to expand the hypothesis presented in this paper to characteristics such as transfer, the amount of practice and other response parameters.

References for Chapter 2


Notes for Chapter 2

\[ E = \sqrt{CE^2 + VE^2} \]
For example, if the goal MTs for each segment were 300-200-400 ms and the observed MTs were 315-168-403 ms, the global timing differences for each segment are +15, -32 and +3, respectively. First, global timing differences such as these were calculated for all trials. Then, for each block of 10 trials, E(GT) was calculated for each movement segment separately. In the example above, the goal MT proportions are 33.3-22.2-44.4% and the observed MT proportions are 35.6-19.0-45.5%, then the relative timing differences for each segment are +2.3, -3.2 and +1.1, respectively. E(RT) was calculated in the same way as E(GT). Since the goal total MT is 900 ms and the observed total MT is 886 ms in this example, the overall duration difference is -14, and E(OD) was derived from each block of 10 trials.
CHAPTER 3: EXPERIMENT 3

Introduction

In terms of practice order, there are several distinct ways in which practice of multiple tasks can be scheduled. For example, practice of task variations can be blocked so that practice of one task is completed before practice of the next task begins. Another schedule could involve practicing task variations in a random order. A third schedule could specify a particular task order that is serially repeated over and over. Both the random and serial practice schedules are thought to create high levels of contextual interference (CI) while the blocked schedule is thought to create a low level of CI.

Research investigating the influence of CI on skill learning (See Magill & Hall, 1990, for a review) has typically shown that a high CI practice schedule hinders acquisition performance but facilitates retention and/or transfer performance compared to a low CI practice schedule. This phenomenon, called the CI effect, was first observed in the motor domain by J. B. Shea and Morgan (1979) and has been found in many studies.

Although the CI effect is a robust phenomenon in motor learning, Magill and Hall (1990) proposed a hypothesis concerning a limitation to the generalizability of the CI effect. According to their hypothesis, the CI effect would be found with task variations governed by different generalized motor programs (GMPs), but should not be found with task variations governed by the same GMP. The GMP, which was popularized by Schmidt (1975, 1985, 1988), is a hypothetical notion for a memory representation for a class of movements which is characterized by invariant features, such as relative timing and relative force. Relative timing and relative force refer to the compositional relationships among movement segments. When these characteristics are invariant, task variations are said to be controlled by the same GMP. Variant features, such as overall duration and overall force, are parameters added to the GMP. Scaling overall movement time (MT) or the overall amount of force can be achieved by modifying the parameters.
added to the GMP without changing the relative timing and relative force structures of the GMP itself.

The underlying rationale for the Magill and Hall (1990) hypothesis is based on an action plan reconstruction view proposed by Lee and Magill (1983, 1985). In contrast to the interference that is created by action plan reconstruction when task variations controlled by different GMPs are practiced under a high Cl condition, parameter modifications of the same GMP are thought to create only minor interference. This minor interference is not sufficient to invoke the effortful information processing that is considered to subsequently facilitate retention and/or transfer performance. Although the Magill and Hall (1990) hypothesis has been supported by many studies (Lee, Wulf & Schmidt, 1992; Wulf, 1992; Wulf & Lee, 1993; also see Magill & Hall, 1990, for a review), some recent studies have shown that the Cl effect can be found when task variations were controlled by the same GMP (Sekiya, Magill, Sidaway & Anderson, 1994; C. H. Shea, Kohl & Indermill, 1990; Young, Cohen & Husak, 1993).

In an attempt to examine the Magill and Hall (1990) hypothesis more closely, Sekiya et al. (1994) used a data analysis technique that modified one used by Wulf and Lee (1993) to dissociate a performance measure that reflected GMP learning from a performance measure that reflected parameter learning. GMP learning was assessed by measuring the proportional accuracy of relative timing, whereas parameter learning was assessed by measuring the accuracy of overall duration. In addition, a general performance measure that reflected both GMP and parameter learning was used. Contrary to the hypothesis, a Cl effect was found for the general performance measure when task variations were controlled by the same GMP. Furthermore, contrary to the underlying rationale of the hypothesis, a clear Cl effect was found for the measure that reflected parameter learning. The Cl effect found for the general performance measure was attributed to the Cl effect found for parameter learning because no Cl effect was found for GMP learning. Based on these findings, Sekiya et al. (1994) proposed a
modification to the Magill and Hall hypothesis by taking into account the processes associated with GMP construction and parameter modifications. According to the new version of the hypothesis, if task variations are controlled by the same GMP the CI effect would be found in parameter learning, but not in GMP learning. Also, this CI effect would be reflected in a general performance measure.

Although Sekiya et al. (1994) used task variations of a timing tapping task that required subjects to modify the overall duration parameter, little is known about modifications of other parameters such as overall force. Although, C. H. Shea et al. (1990) found the CI effect with a force production task that required subjects to modify the overall force parameter of the same GMP, dissociated measures of GMP learning and parameter learning were not employed in that study. Again, while Wulf (1992) showed that modifications of the overall force parameter were not sufficient to create the CI effect unless the frequency of knowledge of results (KR) presentation was reduced, dissociated measures of GMP learning and parameter learning were not reported. Therefore, it is necessary to use the dissociation measurement approach to investigate whether modifications of the overall force parameter of the same GMP creates the CI effect in parameter learning or GMP learning.

Another possible limitation to the generalizability of the CI effect for learning task variations controlled by the same GMP relates to the amount of practice provided to subjects. In C. H. Shea et al. 's (1990) experiment, three different amounts of practice for learning task variations requiring overall force parameter modifications of the same GMP led to an interaction between the amount of practice and the efficacy of the CI effect. The efficacy of the CI effect improved as the number of acquisition trials increased. Based on a hierarchical view of GMP construction and parameter modifications (Schmidt, 1975, 1985, 1988), C. H. Shea et al. argued that early in practice learners needed to acquire fundamental GMP structures, such as relative timing and relative force. During this stage a high level of CI created by parameter modifications
interfered with the acquisition of GMP structures by overloading information processing. Parameter modifications of the same GMP were elaborated at a later stage of learning, suggesting that relatively large number of acquisition trials were necessary for the task variations from the same GMP to create the CI effect.

This notion might explain why the CI effect was not found in the other studies where task variations from the same GMP were practiced with relatively small amounts of practice. It is possible that the number of acquisition trials used in those studies was not adequate to create the CI effect. The relationship between task characteristics and the amount of practice has additional relevance for an understanding of the CI effect because when task variations controlled by different GMPs were learned, there has been no evidence that the amount of practice interacted with the efficacy of the CI effect. For example, with a barrier knock down task that required learning different GMPs, Proteau, Blandin, Alain and Dorion (1994) demonstrated the CI effect equally well for three different amounts of practice. This finding suggested that the CI effect for task variations controlled by different GMPs could be found regardless of the amount of practice, whereas C. H. Shea et al.'s (1990) finding suggested that the CI effect for task variations controlled by the same GMP might interact with the amount of practice. Thus, differences in task characteristics may account for the discrepant results from Proteau et al.'s study and C. H. Shea et al.'s study.

The present study had two purposes. The first extended the experiment by Sekiya et al. (1994) by investigating whether modifications of the overall force parameter would localize the CI effect in parameter learning. The second purpose was to examine the influence of the amount of practice on the CI effect for learning task variations controlled by the same GMP. Subjects practiced task variations that required overall force parameter modifications in either a blocked (low CI) or a serial (high CI) condition. To examine the first purpose of the present study, the dissociation measurement approach was employed in data analyses. If Sekiya et al.'s (1994) findings with overall duration parameter
modifications can be extended to the situation where overall force parameter modifications are required, learning of the overall force parameter (i.e., parameter learning), but not learning of the relative force structure (i.e., GMP learning), should be enhanced by high Cl practice. Also, no Cl effect should occur for measures of relative timing and overall duration because the timing characteristics were identical for all task variations used in this experiment. In addition, the Cl effect observed for overall force parameter learning should be reflected in a measure of general performance that is sensitive to all aspects of performance. To examine the second purpose, two levels of the amount of practice were investigated with the expectation that the efficacy of the Cl effect would increase as the amount of practice increased.

Method

Subjects

Twenty-four university undergraduate students (12 males and 12 females) volunteered as subjects. None had prior experience with the task, and all were naive to the purpose of the experiment. Informed consent was obtained from all subjects.

Apparatus and Task

The apparatus is shown in the top panel of Figure 3.1. The task was to produce spatial-temporal movement patterns on a computer screen by moving a computer mouse with the preferred hand. While seated in front of the apparatus, subjects moved the mouse in a three segment, forward-backward-forward movement in the horizontal plane along a linear track that was placed on a table top at waist level. The rubber surface of the track provided good traction for the mouse. Sensitivity of the mouse was set such that .71 cm of the actual mouse movement along the track corresponded to 1 cm of the mouse cursor movement on the screen. The resolution of movement amplitude measurement was .6 mm.

The bottom panel of Figure 3.1 shows the three variations of the goal pattern, representing small, medium and large amplitudes. Each pattern had three movement
A schematic representation of a subject and the apparatus (top panel), and three task variations represented as spatial-temporal movement patterns (bottom panel). The patterns share the same relative timing, relative amplitude and overall duration characteristics, but have different overall amplitude characteristics.
segments that were generated by sine functions and two non-movement segments that are shown in the bottom panel of Figure 3. 1 as horizontal lines attached on both sides of the curves. Each movement segment consisted of a half cycle of a sine function with a certain amplitude and a certain frequency determined by a MT for each segment. For all patterns, the goal MTs for the first, second and third movement segments were 400 ms, 600 ms and 200 ms, respectively. The goal movement amplitudes for each movement segment were 25.7 mm, 17.1 mm and 8.6 mm, respectively for the small amplitude pattern, 51.3 mm, 34.2 mm and 17.1 mm, respectively for the medium amplitude pattern, and 77.0 mm, 51.3 mm and 25.7 mm, respectively for the large amplitude pattern. The three goal patterns shared the same relative amplitude but had different absolute amplitudes. Producing these patterns required subjects to move the mouse with the same relative force but different absolute forces. Relative timing and overall duration characteristics were identical for all task variations.

**Experimental Groups and Procedure**

For each trial, subjects first located the mouse at the bottom of the track and clicked the left mouse button. Then, a green target cursor appeared on the screen in the position shown in the top panel of Figure 3. 1. The subject's cursor, a red rectangle, also appeared at the bottom of the screen directly below the target cursor. Subjects moved the mouse forward until their cursor was superimposed on the target cursor and then clicked the left mouse button. This procedure was necessary to ensure that the start location was identical for every trial. After the mouse button was hit, one of the goal patterns was displayed on the screen for 2 s. The goal pattern disappeared from the screen and a white line began to extend from the top left edge to the bottom left edge of the screen (See Figure 3. 1). The line movement lasted 1100 ms. Subjects were instructed to initiate their movement coincident with the line reaching the bottom of the screen. In order to produce the goal patterns subjects had to move the mouse forward, backward, and then forward again along the track. While subjects were moving the mouse, they could not
see the goal pattern on the screen. Displacement of the mouse was sampled at 50 Hz for 1800 ms and recorded with an IBM PS2 computer. Recording was initiated 200 ms before the line reached the bottom of the screen and was terminated 1600 ms afterwards. Immediately after the termination of the recording, a root-mean-square (RMS) error was displayed on the screen as KR and the subject-produced pattern (red) was superimposed on the goal pattern (green) as knowledge of performance (KP). The RMS error was derived from deviations of 60 data points in the subject-produced pattern from the time-corresponding 60 data points in the goal pattern. The 60 data points in each pattern were taken from the 1200 ms interval that contained the goal movement segments. These segments are shown in the bottom panel of Figure 3 as sine curves. KR and KP were presented for 4 s and the inter-trial interval was 12 s. Subjects were instructed to reduce the RMS error and discrepancies between the goal and subject-produced patterns.

There were two acquisition sessions, given on consecutive days. Each acquisition session was followed by a 24-hour retention test. Subjects were randomly assigned to either a blocked or serial acquisition condition and performed 270 acquisition trials (90 trials for each task variation) with KR and KP on each of the two acquisition days. The subjects (n = 12) in the blocked acquisition condition completed 90 trials on one task variation before another variation was introduced. The subjects (n = 12) in the serial acquisition condition performed the 270 trials in 90 identical triplets of the three task variations.

On both the second and third days, 30 retention test trials were performed (10 trials for each variation) without KR and KP. Half of the subjects in each acquisition condition were randomly assigned to either a blocked or serial retention test condition. Each pair of acquisition-retention conditions, had an equal number of subjects and had an equal number of males and females. The subjects in the blocked retention condition performed the 30 trials in 3 blocks of 10 trials. The subjects in the serial retention test condition performed the 30 trials in 10 triplets of 3 trials. On day 2, the second
acquisition session was administered immediately after the first retention test. The order in which the task variations were performed was identical for the two acquisition sessions but counterbalanced with a Latin square design across the subjects for each pair of the acquisition-retention conditions. The order of task variations in the retention sessions was identical to the order in which the task variations were introduced in the acquisition sessions.

**Dependent Measures and Statistical Analyses**

To create the 10 dependent measures used in this study, four landmarks in each of subject-produced patterns were digitized by a computer program. These landmarks were the initiation point of the first segment, depicted as an increase in displacement; the transition point from the first to the second segments, depicted as a peak; the transition point from the second to the third segments, depicted as a valley; and, the end point of the third segment, depicted as a point where displacement stopped increasing. These landmarks were also checked by the experimenter to ensure the correctness. The dependent measures are summarized in Table 3.1 showing labels and aspects of performance assessed.

The first dependent measure was the number of excluded trials. Although subjects were instructed to initiate the movement at a correct timing and create the three-segment pattern, subjects sometimes produced a different pattern that had more or fewer than three movement segments. Also, subjects sometimes initiated the movement too early or ended the movement too late such that an entire movement was not recorded during the data recording period. These trials were excluded from data analyses because most of the other dependent measures could not be calculated for these trials. The number of excluded trials was counted for each block of 10 trials for each task variation and was averaged across task variations, resulting in 9 acquisition trial blocks in each acquisition session and 1 retention trial block in each retention test session.
Table 3.1. The Summary of Dependent Measures

<table>
<thead>
<tr>
<th>Dependent Measures</th>
<th>Aspects of Performance Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of excluded trials</td>
<td>Trials excluded from analyses of the other dependent measures</td>
</tr>
<tr>
<td>RMS error: Root mean square error</td>
<td>General performance reflecting all aspects of performance</td>
</tr>
<tr>
<td>ICE(RMV): Absolute constant error of relative mean velocity</td>
<td>Accuracy of the relative force structure of GMP</td>
</tr>
<tr>
<td>VE(RMV): Variable error of relative mean velocity</td>
<td>Consistency of the relative force structure of GMP</td>
</tr>
<tr>
<td>ICE(OMV): Absolute constant error of overall mean velocity</td>
<td>Accuracy of overall force parameter modifications</td>
</tr>
<tr>
<td>VE(OMV): Variable error of overall mean velocity</td>
<td>Consistency of overall force parameter modifications</td>
</tr>
<tr>
<td>ICE(RT): Absolute constant error of relative timing</td>
<td>Accuracy of the relative timing structure of GMP</td>
</tr>
<tr>
<td>VE(RT): Variable error of relative timing</td>
<td>Consistency of the relative timing structure of GMP</td>
</tr>
<tr>
<td>ICE(OD): Absolute constant error of overall duration</td>
<td>Accuracy of overall duration parameter modifications</td>
</tr>
<tr>
<td>VE(OD): Variable error of overall duration</td>
<td>Consistency of overall duration parameter modifications</td>
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</tbody>
</table>
All other dependent measures were calculated for each trial block which consisted of the maximum of 10 trials, depending on the number of excluded trials in each trial block. Thus, there were 9 acquisition trial blocks in each acquisition session and 1 retention trial block in each retention test session. The second dependent measure was the RMS error which was an index of general performance because it was sensitive to all of the other eight dependent measures that assessed different aspects of performance related to force and timing characteristics of the movements. This measure was also sensitive to a phase shift caused by an anticipation timing error for the initiation of the movement. It was calculated in the same way as the RMS error presented to subjects as KR was calculated.

The third and fourth dependent measures were related to GMP learning in terms of force characteristics. For the initial calculation of these measures, mean velocity for each movement segment was determined by dividing an absolute value of movement amplitude by MT for each movement segment. Mean velocity provided an index of the amount of force produced for each movement segment. From each segment's mean velocity, it was then possible to calculate the absolute constant error (ICEI) of relative mean velocity, ICER(MV), which was used as the third dependent measure. This measure assessed the proportional accuracy of relative mean velocity and was derived by calculating ICEI for the differences between the goal mean velocity proportions and the observed mean velocity proportions for each segment of each task variation. The fourth dependent measure was the variable error (VE) of relative mean velocity, VE(RMV), which assessed proportional consistency of relative mean velocity. It was derived by calculating VE for the observed mean velocity proportions for each segment of each task variation.

The fifth and sixth dependent measures were related to overall force parameter learning. Prior to calculating these measures, overall mean velocity was determined by dividing the sum of absolute values of movement amplitudes by total MT. From this
information, the accuracy of the overall force parameter modifications was assessed by ICEI of overall mean velocity, $\text{ICEI(OMV)}$, which was derived by calculating $\text{ICEI}$ for the differences between the goal overall mean velocity and the observed overall mean velocity for each task variation. Next, the consistency of the overall force parameter modifications was assessed by VE of overall mean velocity, which was labeled as $\text{VE(OMV)}$. It was derived by calculating $\text{VE}$ for the observed overall mean velocity for each task variation.

The seventh and eighth dependent measures assessed accuracy and consistency of relative timing, respectively. They were labeled as $\text{ICEI(RT)}$ and $\text{VE(RT)}$ and were derived based on the goal MT proportions and the observed MT proportions for each segment of each task variation. The last two dependent measures assessed accuracy and consistency of overall duration performance, respectively. They were labeled as $\text{ICEI(OD)}$ and $\text{VE(OD)}$ and were derived based on the goal total MTs and the observed total MTs for each task variation.

For statistical analyses, $\text{ICEI(RMV)}$, $\text{VE(RMV)}$, $\text{ICEI(RT)}$ and $\text{VE(RT)}$ were averaged over the movement segments and the task variations, and the RMS error, $\text{ICEI(OMV)}$, $\text{VE(OMV)}$, $\text{ICEI(OD)}$ and $\text{VE(OD)}$ were averaged across the task variations. For acquisition performance, all dependent measures were analyzed separately by $2 \times 2 \times 9$ (Acquisition Condition x Session x Trial Block) ANOVAs with repeated measures on the last two factors. For retention performance, the dependent measures were analyzed separately by $2 \times 2 \times 2$ (Acquisition Condition x Retention Condition x Session) ANOVAs with repeated measures on the last factor. Degrees of freedom for repeated measures were adjusted when the sphericity assumption was violated according to the Greenhouse-Geisser epsilon values (Greenhouse and Geisser, 1959). All post hoc analyses were done with the Tukey's honestly significant difference (HSD) test. To prevent an inflation of the Type-I error rate, the alpha level was adjusted with the Bonferroni method by dividing $.1$ by the number of dependent measures (i.e., $10$). In all analyses, therefore, the rejection region was $p < .01$. 
Results

The Number of Excluded Trials

Acquisition
The analysis of the number of excluded trials in acquisition showed a significant main effect for Session, $F(1, 22) = 15.24, p < .001$, with the second session ($M = .26, SD = .40$) having fewer excluded trials than the first session ($M = .55, SD = .63$). All other main effects or interactions were not significant. The number of excluded trials in acquisition was not different for both acquisition groups. The number of excluded trials for the first and second acquisition sessions was $M = .48, SD = .57$ and $M = .27, SD = .38$, respectively for the blocked acquisition group, and $M = .61, SD = .68$ and $M = .25, SD = .42$, respectively for the serial acquisition group.

Retention
The ANOVA showed no significant main effects or interactions, indicating that the number of excluded trials in retention was not different for both acquisition groups. The number of excluded trials for the first and second retention test sessions was $M = .67, SD = .78$ and $M = 1.53, SD = 1.31$, respectively for the blocked acquisition group, and $M = 1.64, SD = 1.28$ and $M = 1.25, SD = 1.33$, respectively for the serial acquisition group.

General Performance

Acquisition
Figure 3.2 shows the RMS error in the two acquisition and two retention test sessions. The ANOVA revealed a significant main effect for Session, $F (1, 22) = 67.42, p < .001$, and Trial Block, $F (5.5, 120.0) = 21.89, p < .001$. The ANOVA also showed a significant Session x Trial Block interaction, $F (4.1, 91.2) = 5.60, p < .001$, indicating that performance improvement was more rapid during the first session of practice than during the second. All other main effects or interactions were not significant.
Figure 3.2. Mean RMS error during two acquisition sessions and two retention test sessions for the blocked and serial acquisition groups. Each data point was calculated from each trial block, and averaged over the task variations and subjects.
Retention

The analysis of the RMS error revealed a significant main effect only for Acquisition Condition, $F(1, 20) = 9.70, p < .01$. The serial acquisition group ($M = 11.1$ mm, $SD = 2.4$ mm) showed general performance superior to the blocked acquisition group ($M = 14.6$ mm, $SD = 4.5$ mm), with an effect size of .96 for this difference. Because no interactions were significant, a clear CI effect was demonstrated in both retention test sessions.

Accuracy of Relative Mean Velocity

Acquisition

The analysis of ICEI(RMV) revealed a significant main effect only for Session, $F(1, 22) = 9.02, p < .01$, with the second acquisition session ($M = 7.5\%$, $SD = 1.6\%$) showing smaller ICEI(RMV) than the first acquisition session ($M = 8.1\%$, $SD = 1.7\%$). This indicates that accuracy of the relative force structure improved from the first to the second day of practice. There were no significant interactions.

Retention

The analysis of ICEI(RMV) in retention showed no significant main effects or interactions, indicating no CI effect for the accuracy of the relative force structure.

Consistency of Relative Mean Velocity

Acquisition

The analysis of VE(RMV) revealed a significant main effect for Session, $F(1, 22) = 19.10, p < .001$, with the second acquisition session ($M = 4.3\%$, $SD = 1.0\%$) showing less VE(RMV) than the first acquisition session ($M = 4.6\%$, $SD = 1.0\%$). The ANOVA also revealed a significant main effect for Trial Block, $F(5.0, 109.5), p < .001$. Because the Session x Trial Block interaction failed significance, $F(5.7, 125.1) = 2.42, p > .01$, the consistency of the relative force structure improved throughout the two acquisition sessions. No other main effects or interactions were significant.
Retention. The ANOVA revealed no significant main effects or interactions. There was no CI effect for the consistency of the relative force structure.

Accuracy of Overall Mean Velocity

Acquisition

Figure 3.3 shows ICE(OMV) during the two acquisition sessions and the two retention test sessions for each acquisition group. The ANOVA revealed a significant main effect for Session, $F(1, 22) = 8.15, p < .01$, and Trial Block, $F(3.3, 73.6) = 7.19, p < .001$. This indicates that the accuracy of overall force parameter modifications improved throughout the two acquisition sessions. All other main effects or interactions were not significant.

Retention

The ANOVA showed a significant main effect only for Acquisition Condition, $F(1, 20) = 9.24, p < .01$. The serial acquisition group ($M = 19.2 \text{ mm/s}, SD = 12.1 \text{ mm/s}$) had smaller ICE(OMV) than the blocked acquisition group ($M = 37.6 \text{ mm/s}, SD = 26.9 \text{ mm/s}$), with an effect size of .88 for this difference. Because no interactions were significant, the CI effect for overall force parameter learning was observed in both retention test sessions.

Consistency of Overall Mean Velocity

Acquisition

The analysis of VE(OMV) revealed a significant main effect for Session, $F(1, 22) = 20.92, p < .001$, with the second acquisition session ($M = 15.2 \text{ mm/s}, SD = 5.6 \text{ mm/s}$) having less VE(OMV) than the first acquisition session ($M = 19.3 \text{ mm/s}, SD = 9.1 \text{ mm/s}$). There was also a significant main effect for Trial Block, $F(3.2, 69.5) = 10.83, p < .001$. Because the Session x Trial Block interaction failed significance, $F(3.7, 81.8) = 3.66, p > .01$, the consistency of overall force parameter modifications improved throughout the two acquisition sessions. No other main effects or interactions were significant.
Figure 3.3: Absolute constant error of overall mean velocity, ICEI(OMV), during two acquisition sessions and two retention test sessions for the blocked and serial acquisition groups. Each data point was calculated from each trial block, and averaged over the task variations and subjects.
Retention

No significant main effects or interactions were found in the analysis of VE(OMV) during the retention test sessions. Thus, the Cl effect was not observed for the consistency of overall force parameter modifications.

Accuracy of Relative Timing

Acquisition

The ANOVA revealed no significant main effects or interactions. Although the second acquisition session ($M = 8.2\%, SD = 2.0\%$) had less ICEI(RT) than the first acquisition session ($M = 8.8\%, SD = 1.7\%$), the Session main effect failed to be significant, $F(1, 22) = 4.44, p = .05$.

Retention

The ANOVA revealed a significant main effect for Session, $F(1, 20) = 8.65, p < .01$, with the second retention test ($M = 8.1\%, SD = 1.6\%$) having less ICEI(RT) than the first retention test ($M = 8.7\%, SD = 1.9\%$). This indicated that the accuracy of relative timing structure was learned better after the second acquisition session than the first acquisition session. Because no other main effects or interactions were significant, there was no Cl effect for the accuracy of relative timing structure.

Consistency of Relative Timing

Acquisition

The analysis of VE(RT) showed significant main effects for Session, $F(1, 22) = 34.44, p < .001$, and Trial Block, $F(5.5, 121.3) = 6.92, p < .001$. No other main effects or interactions were significant. Thus, the consistency of relative timing structure improved throughout acquisition.

Retention

The ANOVA revealed no significant main effects or interactions, indicating no Cl effect for the consistency of relative timing.
Accuracy of Overall Duration

Acquisition

The analysis of ICE(OD) revealed no main effects or interactions.

Retention

The ANOVA revealed no main effects or interactions, indicating no Cl effect for the accuracy of overall duration parameter modifications.

Consistency of Overall Duration

Acquisition

The analysis of VE(OD) in acquisition showed a significant main effect for Session, $F(1, 22) = 33.16, p < .001$, with the second acquisition session ($M = 101.2$ ms, $SD = 29.2$ ms) having less VE(OD) than the first acquisition session ($M = 116.7$ ms, $SD = 33.8$ ms). The ANOVA also revealed a significant main effect for Trial Block, $F(5.1, 111.6) = 8.84, p < .001$. Because no other main effects or interactions were significant, the consistency of overall duration parameter modifications improved throughout acquisition.

Retention

The analysis of VE(OD) in retention showed no significant main effects or interactions. Thus, no Cl effect was found for the consistency of overall duration parameter modifications.

Discussion

The first purpose of the present study was to examine if overall force parameter modifications of the same GMP could create the Cl effect and, if the Cl effect was found, to further examine whether its locus was in GMP learning or parameter learning. The results showed that general performance during retention was enhanced by a high level of CI during acquisition. It is important to note that while there were no group differences in acquisition, this result is consistent with a number of experiments investigating the Cl effect (e.g., Goode & Magill, 1986; Young, Cohen, & Husak, 1993). The most
important aspect of the CI effect is the group difference in retention because it is this test that reflects the amount of learning promoted by the various levels of CI in acquisition (Chamberlin & Lee, 1993). Therefore, the lack of group differences in acquisition should not be viewed as weakening the CI effect in this experiment. The significance of finding the CI effect for the general performance measure is that it supports Sekiya et al.'s (1994) finding that retention of task variations controlled by the same GMP was enhanced by high CI practice. However, it clearly contradicts the Magill and Hall (1990) hypothesis that predicts no CI effect for task variations from the same GMP.

Although the CI effect was found for the general performance measure that reflected different aspects of performance, it was not clear which aspect of performance created the CI effect. It was therefore necessary to dissociate all aspects of performance in the data analyses to examine the locus of the CI effect. As a result of this dissociation, it was possible to measure the accuracy and consistency of performance associated with GMP and parameter learning for each of force and timing characteristics. The acquisition results showed that all aspects of performance, except for the accuracy of relative timing and overall duration, improved with practice. Although, no group differences during acquisition were found for any of these dissociated measures, it did not deny the possibility for finding the CI effect in retention based on the same rationale discussed for the general performance measure. In addition, it is possible that different levels of CI were not reflected in these measures because they were designed to measure different aspects of performance but were not specifically designed to measure the amount of interference created by the acquisition conditions.

The retention results revealed that the CI effect was found only for the measure that assessed the accuracy of overall force parameter modifications. Subjects in the high CI acquisition condition had to modify the overall force parameter from one trial to the next during acquisition and this modification process created sufficient interference, though it was not reflected in acquisition performance, to subsequently facilitate retention
performance. As the Cl effect was not found for the consistency of overall force parameter modifications, it appeared that only the accuracy of parameter learning was enhanced by high Cl practice.

On the other hand, there was no Cl effect in either of the measures that assessed the accuracy and consistency of the relative force structure. This finding supports an assumption made by Magill and Hall (1990) that the GMP reconstruction process is bypassed from one trial to the next when task variations share the same GMP. Because there was no source of interference related to the relative force structure, information processing activity associated with GMP learning was identical for both acquisition conditions. In addition, no Cl effect was found for all aspects of performance associated with timing characteristics because all task variations shared the same timing characteristics and therefore created no source of Cl for both acquisition groups.

In summary, the results showed that overall force parameter learning, but not GMP learning concerning force characteristics, was enhanced by high Cl practice. No Cl effect was found for either parameter or GMP learning of timing characteristics. Furthermore, the Cl effect found for overall force parameter learning was also reflected in the general performance measure. These findings, which were based on overall force parameter modifications of the same GMP, replicate and extend those by Sekiya et al. (1994), which were based on overall duration parameter modifications of the same GMP. Taken together, these two sets of results indicate that when parameter modifications are required from trial to trial, sufficient interference can be created to facilitate the learning of parameter modifications. However, sufficient interference is not created to produce the Cl effect for learning GMP structures. In other words, the aspect of the task that is changed from one trial to the next is the aspect of the task that is facilitated in retention.

The second purpose of the present study was to consider the influence of the amount of practice on the Cl effect. Although two levels of the amount of practice were used in the present experiment to examine an interaction between the efficacy of the Cl
effect and the amount of practice, the CI effect that was found for both overall force parameter learning and the general performance measure was not influenced by the amount of practice. This finding is not consistent with the results of C. H. Shea et al. (1990) who found that the efficacy of the CI effect increased as the amount of practice increased. According to C. H. Shea et al., the CI effect may not be found in the early stage of learning skill variations controlled by the same GMP because parameter modifications are more elaborated after fundamental structures of the GMP are established. It is not clear whether the present results contradict this notion, because the two levels of the amount of practice used may have been sufficient to allow the elaboration of task parameters. Although 270 acquisition trials is a relatively large number of acquisition trials, it may be necessary to involve smaller amounts of practice to examine C. H. Shea et al.'s (1990) notion in future research. Additionally, if the interaction between the amount of practice and the CI effect is found, then it may be necessary to further examine whether this interaction is limited to the same GMP task variations because Proteau et al. (1994) did not find such an interaction for different GMP task variations.

Although the present finding that task variations controlled by the same GMP can produce the CI effect supports findings by Sekiya et al. (1994), C. H. Shea et al. (1990), and Young et al. (1993), it contradicts the Magill and Hall (1990) hypothesis and findings by Lee et al. (1992), Wulf (1992), and Wulf and Lee (1993). It is necessary to clarify these inconsistent findings by further examining the influence of the amount of practice on the CI effect. In addition, the findings of the present study should be restricted to the CI effect in retention, because Wulf and Lee (1993) found that GMP learning, but not parameter learning, was enhanced by high CI practice when learning was assessed with transfer tests. Clearly, more research is necessary to clarify this discrepancy between the retention and transfer findings.
References for Chapter 3


Notes for Chapter 3

1 RMS error = \( \sqrt{\frac{1}{60} \sum_{t=1}^{60} (GD_t - SD_t)^2} \)

where GD\(_t\) = goal displacement at moment t and SD\(_t\) = subject's displacement at moment t.

2 It was assumed that the mean velocity for a movement segment reflects the amount of force produced for that movement segment, because the distance an object moves in a certain period of time (i.e., mean velocity) is directly related to the amount of force produced (Schmidt, 1982). Additionally, this assumption is supported by the fact that the amount of force produced to match the goal pattern is proportional to an impulse for acceleration, which is the area under the time-acceleration curve, because mass of the objects (e.g., subject’s limb and the computer mouse) are constant within a subject in the present study. The impulse for acceleration is commonly used as an index of the amount of force (Carlton & Newell, 1993) and is proportional to mean velocity in the present study due to the nature of the sine function.

3 For example, the goal MTs for the first, second, and third segments of the medium amplitude pattern were 400 ms, 600 ms, and 200 ms, respectively. Because the goal amplitudes for each segment of this pattern were 51.3 mm, 34.2 mm, and 17.1 mm, respectively, the goal mean velocities for each segment were 128.3 mm/s, 57.0 mm/s, and 85.5 mm/s, respectively. If the observed MTs for each segment were 300 ms, 500 ms, and 100 ms, respectively, and the observed amplitudes for each segment were 45.0
mm, 30.0 mm, and 10.0 mm, respectively, the observed mean velocities would be 150.0 mm/s, 60.0 mm/s, and 100.0 mm/s, respectively.

In this case, the goal mean velocity proportions for each segment would be 47.4%, 21.0%, and 31.6%, respectively, and the observed mean velocity proportions would be 48.4%, 19.3%, and 32.3%, respectively. The differences between the goal and observed mean velocity proportions for each segment would be 1.0%, -1.7%, and 0.7%, respectively. The ICE(RMV) and VE(RMV) for each movement segment were derived based on these differences from each trial block. Also, the goal overall mean velocity would be 42.8 mm/s and the observed total mean velocity would be 94.4 mm/s. The difference between the goal and observed overall mean velocities would be 51.6 mm/s. The ICE(OMV) and VE(OMV) were derived based on these differences from each trial block.

The goal MT proportions would be 33.3%, 50.0%, and 16.7%, respectively, and the observed MT proportions would be 33.3%, 55.6%, and 11.1%, respectively. The differences between the goal and observed MT proportions would be 0%, 5.6%, and -5.6%, respectively. The ICE(RT) and VE(RT) for each segment were calculated based on these differences for each trial block. Also, the goal total MT would be 1200 ms and the observed total MT would be 900 ms. The difference between the goal and observed total MTs for each segment would be -300 ms. The ICE(OD) and VE(OD) were calculated based on these differences for each trial block.

In addition, it should be noted that a variety of amplitude-MT combinations could produce an identical mean velocity as far as an amplitude-MT ratio is constant. It was therefore possible to have the observed mean velocity proportions that were similar to the goal mean velocity proportions but with the observed MT proportions that were not similar to the goal MT proportions. However, it was an advantage, but not a disadvantage, of the dependent measures used in this study to dissociate measures of learning relative force structures from measures of learning relative timing structures because the primary purpose of the data analyses was to dissociate different aspects of performance.

Separate ANOVAs were used instead of a MANOVA, because the primary purpose of the data analysis in the present study was to dissociate one performance measure from the other. The use of ANOVAs is also justified by multicollinearity due to a lack of independency among the dependent measures used in the present study. Also, the analysis of retention performance was separated from the analysis of acquisition performance in order not to confound the relatively permanent learning effects with temporary performance effects.
CHAPTER 4: EXPERIMENT 4

Introduction

When multiple motor tasks are learned, random practice where tasks are practiced in unsystematic order and serial practice where tasks are repeated in a fixed order create higher levels of contextual interference (CI) than blocked practice where practice of one task is completed before practice of another task begins. Typically, high CI practice hinders acquisition performance but facilitates retention and/or transfer compared to low CI practice. This phenomenon, called the CI effect, has been found in many studies since J. B. Shea and Morgan (1979) first found it in the domain of motor skills (See Magill & Hall, 1990, for a review).

Magill and Hall (1990) proposed a hypothesis concerning generalizability of the CI effect from a task characteristics perspective. According to their hypothesis, the CI effect is unlikely to occur when task variations are controlled by the same generalized motor program (GMP). The GMP is a hypothetical notion for memory representation of a class of movements and is characterized by invariant features, such as relative timing and relative force (Schmidt, 1975, 1985, 1988). When task variations share the same invariant features, they are considered to be controlled by the same GMP. Variant features, such as overall duration and overall force, are parameters added to the GMP and scaling of the movement can be achieved by modifying only parameters without changing the invariant GMP structures.

The Magill and Hall (1990) hypothesis was based on an action plan reconstruction view proposed by Lee and Magill (1983, 1985) to explain the CI effect. Magill and Hall argued that when task variations controlled by the same GMP are practiced in a random or serial order, only minor interference is created because only parameters of an action plan need to be modified from one trial to another. Because this minor interference created under random or serial practice is similar to that created under blocked CI practice, retention and transfer are not enhanced by such practice and so no CI effect is predicted to
occur. In contrast, when task variations from different GMPs are learned, practice that requires both GMP reconstruction and parameter modifications from trial to trial leads to a higher level of CI compared to that created under blocked practice. Thus, the CI effect is predicted to occur when task variations controlled by different GMPs are learned.

Recent studies investigating the Magill and Hall (1990) hypothesis have however reported inconsistent findings. Basically, there have been two ways to test the hypothesis. One way to examine the hypothesis has been to use a within-study comparison of the same versus different GMP task variations. Lee, Wulf and Schmidt (1992), using variations of a timing-tapping task which had either the same or different relative timing structures, found that only different GMP task variations produced the CI effect in transfer, while no CI effect was found in retention regardless of task characteristics. Although Lee et al.'s findings partially supported the Magill and Hall hypothesis, Hall and Magill (in press), using task variations similar to those used by Lee et al., found the CI effect in many different types of retention and transfer tests regardless of task characteristics. Although Hall and Magill concluded that the CI effect was found only for different GMP task variations, no interaction between the task characteristics and the CI effect was found for all CI effects found in their study. Therefore, both types of task variations produced the CI effect in this study contrary to authors' claim.

Another way to examine the Magill and Hall (1990) hypothesis has been to use a data analysis technique that dissociates measures related to GMP learning from measures related to parameter learning. The advantage of using the dissociation measurement technique is that it can test the basis of the Magill and Hall hypothesis that parameter modifications do not create sufficient interference to subsequently facilitate retention and transfer. Wulf and Lee (1993), with the same GMP task variations of a tapping task similar to those used by Lee et al. (1992) and Hall and Magill (in press), found no CI effect for the measure of parameter learning. However, Sekiya, Magill and Anderson (1995), using task variations that required modifications of the overall force parameter of
the same GMP, found the CI effect in parameter learning contrary to the prediction of the Magill and Hall hypothesis.

Sekiya, Magill, Sidaway and Anderson (1994) used both within-study and dissociation measurement approaches to examine the Magill and Hall (1990) hypothesis more closely. Using task variations similar to those used by Lee et al. (1992) and Hall and Magill (in press), Sekiya et al. found the CI effect in retention regardless of task characteristics, contrary to the Magill and Hall hypothesis. Furthermore, analyses of the dissociated measures revealed that the CI effect found for a general performance measure was attributed to parameter learning but not GMP learning, contrary to the rationale for the Magill and Hall hypothesis.

Although the results of some studies are consistent with the Magill and Hall (1990) hypothesis, the results of the other studies clearly contradict it. These inconsistent findings may be clarified when the influence of the amount of practice on the CI effect is considered, because C. H. Shea, Kohl and Indermill (1990) have found an interaction between the amount of practice and the efficacy of the CI effect with task variations controlled by the same GMP. In this study, variations of a rapid force production task, which required modifications of the overall force parameter of the same GMP, were practiced under either a blocked or random context for 50, 200 or 400 trials. One day after acquisition, retention performance was measured under either a blocked or random context. After 50 acquisition trials, no CI effect was found or even the blocked practice group performed better than the random practice group under the random retention test. In contrast, a clear CI effect was found regardless of the test contexts after 400 trials. A somewhat moderate effect was found after 200 trials because the CI effect was found only under the random retention test.

This interaction between the amount of practice and the CI effect can be observed when the studies investigating the Magill and Hall (1990) hypothesis are reviewed in the light of the amount of practice. There is a tendency for the Magill and Hall hypothesis not
to be supported when the amount of practice is relatively large. For example, the
numbers of acquisition trials used in the studies supporting the hypothesis were 108
(Wulf & Lee, 1993), 90 and 180 (Lee et al., 1992), whereas the numbers of acquisition
trials used in the studies that did not support the hypothesis were 198 (Hall & Magill, in
press), 270 (Sekiya et al., 1994; Experiment 2), 270 and 540 (Sekiya et al., 1995).

This interaction between the amount of practice and the CI effect can also be
observed when other studies using task variations that are considered to be controlled by
the same GMP are reviewed. For example, no CI effect was found when variations of a
pursuit rotor task were practiced for 15 (Heitman & Gilley, 1989) and 50 trials
(Whitehurst & Del Rey, 1983). Variations of a linear positioning task with 15 acquisition
trials also showed no CI effect (Turnbull & Dickinson, 1986). When subjects practiced
producing the goal spatio-temporal movement patterns that differed only in the amount of
overall force, 90 acquisition trials led to no CI effect unless KR presentation was
manipulated (Wulf, 1992). In contrast to these studies with relatively small numbers of
trials, the CI effect was found when variations of a rapid aiming task were practiced for
192 trials (Young, Cohen & Husak, 1993). Although an exact number of trials that
differentiates a relatively large from a relatively small amount of practice is not important
due to differences in the nature of the tasks used, a general tendency toward the increased
possibility of finding the CI effect as a function of the amount of practice should be
noticed.

On the other hand, when task variations are controlled by different GMPs, the CI
effect is likely to occur regardless of the amount of practice. For example, Proteau,
Blandin, Alain and Dorion (1994), using a barrier knockdown task with different
movement patterns, found the CI effect equally well after 54, 108 and 216 acquisition
trials. Between study comparisons also support this notion. For example, the CI effect
was found when variations of a barrier knockdown task were practiced only for 54 (Al-
Ameer & Toole, 1993; Del Rey, Liu & Simpson, 1994; Lee & Magill, 1983; Limons &
Shea, 1988; J. B. Shea & Titzer, 1993; Wright, Li & Whitacre, 1992) and 60 trials (Lee, Magill & Weeks, 1985). The CI effect was also found when hitting buttons in different movement patterns was practiced for 135 trials (Meeuwsen & Magill, 1991; Experiment 3). When variations of a tapping timing task had different relative timing structures, the CI effect was found after 198 (Hall & Magill, in press) and 270 acquisition trials (Sekiya et al., 1994; Experiment 1).

Taken together, the CI effect has been found only after a relatively large amount of practice when task variations were controlled by the same GMP, whereas the CI effect has been found after any amount of practice when task variations were controlled by different GMPs. If the amount of practice influences the efficacy of the CI effect when task variations are controlled by the same GMP, the Magill and Hall (1990) hypothesis is supported under a situation where only a small amount of practice is available. Therefore, it is necessary to further investigate this possible interaction between the amount of practice and the CI effect, because this interaction was derived based only on the between-study comparisons and only one within-study comparison by C. H. Shea et al. (1990).

In addition, C. H. Shea et al. (1990) explained their findings by recourse to a hierarchical structure of the GMP and parameters. They argued that parameter modifications required under high CI practice might overload a subject’s processing capacity in early practice because acquisition of fundamental GMP structures needs more attention than parameter modifications. In contrast, low CI practice enabled subjects to focus on the fundamental GMP structures and resulted in the better learning. However, as subjects acquired the GMP structures with the increased amount of practice, their focus shifted from the GMP structures to the parameters. In later practice, subjects in high CI practice were more actively engaged in parameter modifications than subjects in low CI practice because parameters needed to be modified from trial to trial to a greater extent in high CI practice, leading to subsequent facilitation of retention performance.
Although C. H. Shea et al. (1990) did not state whether the CI effect should be found in GMP learning or parameter learning after different amounts of practice, it is possible to derive two predictions based on their explanation. First, in early practice low CI practice should lead to better GMP learning than high CI practice because high CI practice requires parameter modifications and prevents subjects from paying sufficient attention to acquisition of the GMP structures in this stage. Second, in later practice high CI practice would lead to better parameter learning than low CI practice because high CI practice would engage subjects in more effortful processing of parameter modifications. Because C. H. Shea et al. did not dissociate parameter learning from GMP learning in the measurement due to the nature of the task they used, validity of these predictions is still undetermined. It is necessary to examine these predictions using the dissociation measurement technique.

Therefore, the first purpose of the present study was to investigate the interaction between the amount of practice and the efficacy of the CI effect with task variations controlled by the same GMP to clarify the inconsistent findings concerning the Magill and Hall (1990) hypothesis. The predictions derived from C. H. Shea et al.’s possible explanation for this interaction is tested by dissociating GMP learning from parameter learning in data analyses.

Another factor which may be responsible for the inconsistent findings from the studies investigating the Magill and Hall (1990) hypothesis concerns types of tests used to assess the CI effects. Wulf and Lee (1993) found, in a delayed transfer test, that high CI practice of task variations controlled by the same GMP led to better GMP learning than low CI practice. They also found, in an immediate transfer test, that high CI practice led to parameter learning that was inferior to low CI practice. They then concluded that the CI effect is not found in a general performance measure when task variations are controlled by the same GMP because the detrimental effect on parameter learning and the beneficial effect on GMP learning cancel each other out. On the other hand, Sekiya et
al.'s (1994, 1995) findings based on retention tests showed that parameter learning was enhanced by high CI practice and no differences due to practice schedules were found for GMP learning.

This inconsistency between the retention and transfer findings is not predicted by the notion that the same processing mechanism underlies retention and transfer of skill learning. A schema theory proposed by Schmidt (1975) holds that an abstract form of memory representation is the basis of parameter modifications that is required for both retention and transfer. The schema theory predicts that findings based on transfer tests that require parameter modifications of the same GMP that was learned during practice, which was the case in the study by Wulf and Lee (1993), would be compatible with findings based on retention tests that require parameter modifications of the same GMP, which was the case in the studies by Sekiya et al. (1994, 1995). More research is needed to clarify the discrepancies between the retention and transfer findings. Therefore, the second purpose of the present study was to reexamine the CI effect in retention and transfer within the same study using the dissociated measures for GMP and parameter learning.

Another issue addressed in the present study concerns simultaneous modifications of timing and force parameters. In most of the studies investigating the Magill and Hall (1990) hypothesis, variations of a timing tapping task were used (Hall & Magill, in press; Lee et al., 1992, Sekiya et al., 1994; Wulf & Lee, 1993). In these studies, the task variations were considered to require modifications of the overall duration parameter and only timing components were measured and reported. However, it was possible for subjects in these studies to modify both timing and force parameters at the same time, because timing characteristics could be changed by changing speed of the movement, which was a direct function of the amount of force produced. It is unknown whether both timing and force parameters were modified in these studies and, whether the CI effect found in some of the studies (Hall & Magill, in press; Sekiya et al., 1994) could be
attributed to both overall duration and overall force parameter learning. Therefore, it was the third purpose of the present study to investigate the Cl effect with simultaneous modifications of both overall duration and overall force parameters of the same GMP.

In summary, the present experiment addressed the three issues concerning the Cl effect that remain unresolved. The first concerns the influence of the amount of practice on the Cl effect. To address this issue three different amounts of practice were used. It was predicted that the efficacy of the Cl effect would increase as the amount of practice increased. The second purpose, concerning the discrepancies between the retention and transfer findings, was pursued by using both retention and transfer tests in the same experiment. If the previous findings are reliable, retention results would replicate the findings by Sekiya et al. (1994, 1995) while transfer results would replicate the findings by Wulf and Lee (1993). The third purpose, concerning the simultaneous modifications of the overall duration and overall force parameters of the same GMP, was pursued by measuring both timing and force components. On the basis of the previous studies (Sekiya et al., 1994, 1995), it was predicted that the Cl effect would be found for learning of both overall duration and overall force parameters.

Method

Subjects

Twenty-four right-handed university students (16 males and 8 females; Mean age = 21.4 years, SD = 1.8 years) served as subjects. None had prior experience with the task, and all were naive to the purpose of the experiment. Informed consent was obtained from all subjects.

Apparatus and Task

The apparatus consisted of a metal lever affixed at one end to a virtually frictionless vertical axle. The axle was supported by a ball bearings block that was fixed to a table. A hand grip was attached to the other end of the lever so that a subject could hold the lever by the right hand and move the lever freely in the horizontal plane over the
The position of the hand grip was adjusted for each subject such that the elbow was located over the axle. An analog potentiometer was attached to the bottom end of the axle and locations of the lever in the horizontal plane were recorded as digital signals with an analog-digital converter installed in IBM PS/2 computer. The resolution of angular displacement measurement was .18°.

The task was to produce spatio-temporal movement patterns on a computer screen by moving the lever. Figure 4.1 shows the three variations of the goal movement pattern for acquisition and retention and the three variations of the goal pattern for transfer. In order to produce these goal patterns, subjects had to move the lever in a three segment, outward-inward-outward movement. Each goal pattern had three movement segments that were generated by sine functions and two non-movement segments that are shown in Figure 4.1 as horizontal lines attached on both sides of the curves. Each movement segment consisted of a half cycle of a sine function with a certain amplitude and a certain frequency determined by MT for each movement segment. During acquisition and retention, the goal MTs for the first, second and third segments were 180 ms, 450 ms and 300 ms, respectively for the large amplitude pattern, 240 ms, 600 ms and 400 ms, respectively for the medium amplitude pattern, and 300 ms, 750 ms and 500 ms, respectively for the small amplitude pattern. The goal movement amplitudes for each movement segment during acquisition and retention were 30°, 45° and 15°, respectively for the large amplitude pattern, 20°, 30° and 10°, respectively for the medium amplitude pattern, and 10°, 15° and 5°, respectively for the small amplitude pattern. During transfer, the goal MTs for each segment were 150 ms, 375 ms and 250 ms, respectively for the large amplitude pattern, 210 ms, 525 ms and 350 ms, respectively for the medium amplitude pattern, and 270 ms, 675 ms and 450 ms, respectively for the small amplitude pattern. The goal amplitudes for each segment during transfer were 35°, 52.5° and 17.5°, respectively for the large amplitude pattern, 25°, 37.5° and 12.5°, respectively for the
Figure 4.1. Spatio-temporal movement patterns of task variations during acquisition, retention and transfer
medium amplitude pattern, and 15°, 22.5° and 7.5°, respectively for the small amplitude pattern.

All variations of the goal pattern shared the same relative timing and the same relative amplitude but had different total MTs and different absolute amplitudes. Producing these patterns required subjects to move the lever with the same relative timing and the same relative force but different total MTs and different overall amounts of force. Thus, the variations required learning modifications of both overall duration and overall force parameters of the same GMP.

Experimental Groups and Procedure

Each trial began when one of the goal patterns was shown on the screen. Subjects then located the lever at a start position that was 45° away from the subject's frontal plane in a clockwise direction. One second after the lever was located at the start position, the goal pattern disappeared from the screen and subjects heard a short beep sound twice in a row. Each beep sounded for 20 ms and the interval between the two beeps was 700 ms. Subjects were instructed to initiate the movement when they thought they would hear an imaginary third beep with same interval of 700 ms between the second and third beeps, though the third beep did not actually sound. For each trial, angular displacement of the lever was sampled at 200 Hz for 3 s. Recording was initiated 400 ms after the second beep, that is, 300 ms before the imaginary third beep at which subjects were supposed to initiate the movement. While subjects were moving the lever, nothing was shown on the screen.

Immediately after the termination of recording, angular displacement data were smoothed with a Butterworth-type low-pass filter of second order. To prevent a phase shift created by filtering, once-filtered data were filtered again in the reverse direction. The cut-off frequency for filtering was 5 Hz. This cut-off frequency was chosen based on a residual analysis so that the amount of signal distortion equaled the amount of noise passed through the filter. The filtered data were recorded as the subject-produced spatio-
temporal pattern. Two seconds after the termination of recording, a root-mean-square (RMS) error was displayed on the screen as KR and the subject-produced pattern (red) was superimposed over the goal pattern (green) as knowledge of performance (KP). The RMS error was derived from discrepancies between the angular displacement of the subject-produced pattern and the time-corresponding angular displacement of the goal pattern.\textsuperscript{1} Data points used for the RMS error calculation were those from the initiation of recording to 300 ms after the end point of the third goal movement segment. Thus, in addition to the duration of the three goal movement segments, durations of 300 ms before and after the goal movement segments were also involved in the RMS error calculation to reflect a phase shift that could possibly be created as a result of an anticipation coincident timing error for the initiation of the movement. KR and KP were displayed for 5 s and the inter-trial interval was 15 s. Subjects were instructed to decrease the discrepancies between the subject-produced and goal patterns and the RMS error.

There were three acquisition sessions and three retention and transfer test sessions. On the first day of the experiment for each subject, the first acquisition session was administered. On the second day, subjects had the first retention test session, followed by the first transfer test session which was followed by the second acquisition session. The third day consisted of the second retention test session, the second transfer test session and the third acquisition session in that order. On the fourth day, subjects had the third retention and transfer test sessions. Thus, each acquisition session was followed by the one-day retention and transfer tests. Subjects were randomly assigned to either a blocked or serial acquisition condition and performed 60, 120 and 180 trials with KR in the first, second and third acquisition sessions, respectively. Thus, total numbers of acquisition trials performed before the first, second and third retention and transfer test sessions were 60, 180 and 360, respectively. All task variations had an equal number of trials in each acquisition session.
Subjects in the blocked acquisition condition performed one task variation repeatedly before the next task variation was practiced. Subjects in the serial acquisition condition repeated a set of three trials in which each of the three task variations appeared once in a fixed order. During each retention test session, the patterns practiced during acquisition were performed without KR for 15 trials. To counter-balance the retention test conditions for each acquisition condition, retention performance for half of the subjects in each acquisition condition was tested under the same schedule as experienced in acquisition, whereas the other half of the subjects were tested under the opposite schedule from their acquisition condition. During each transfer test session, the three task variations, which had the same relative timing and relative amplitude as those practiced in acquisition but had novel overall durations and overall amplitudes, were performed without KR for 15 trials. Transfer test conditions were identical to the retention test conditions for all subjects so that the transfer conditions were also counter-balanced for each acquisition condition. Each pair of acquisition-retention/transfer test conditions had an equal number of subjects (n = 6) and had an equal number of males (n = 4) and females (n = 2). The order in which task variations were performed was randomized for all subjects. The order of task variations in the retention and transfer tests was identical to the order in which the task variations were introduced in acquisition.

**Dependent Measures and Statistical Analyses**

Four landmarks in each subject-produced pattern were digitized with a computer program to create 10 dependent measures used in this study. These landmarks were the initiation point of the first segment, depicted as a .2° or greater increment in angular displacement; the transition point from the first to the second segments, depicted as a peak value in angular displacement; the transition point from the second to the third segments, depicted as the least value in angular displacement; and the end point of the third segment, depicted as a point where an increment in angular displacement became .2° or less. These
landmarks digitized by the computer program were also checked by the experimenter to ensure correctness.

Table 4.1 summarizes the dependent measures used in this study. The first dependent measure was the number of excluded trials. Whenever all landmarks were not recognized due to subject's failure to produce the three movement segments in a correct order and within the data recording period, those trials were excluded from data analyses because most of the other dependent measures could not be calculated. The number of excluded trials was counted for each block of 10 trials in acquisition and each block of 5 trials in retention and transfer for each task variation and was averaged over task variations. This blocking procedure resulted in 2, 4 and 6 trial blocks in the first, second and third acquisition sessions, respectively, and 1 trial block for each retention or transfer test session. The same blocking procedure was used for all other dependent measures, but the number of trials used for calculations of these dependent measures depended on the number of excluded trials contained in each trial block.

The second dependent measure was the RMS error that was used as an index of general performance because it reflected different aspects of performance related to both timing and force characteristics, which were separately measured by the other eight dependent measures. The RMS error was also sensitive to a phase shift caused by an anticipation coincident timing error for the movement initiation. This RMS error was calculated in the same way as the RMS error presented to subjects as KR during acquisition.

The third and fourth dependent measures were related to GMP learning in terms of timing characteristics. The third dependent measure was the absolute constant error (ICEI) of relative timing, ICEI(RT), which assessed the proportional accuracy of the relative timing structure. It was derived by calculating ICEI for the differences between the observed and goal MT proportions for each segment of each task variation. The fourth dependent measure was the variable error (VE) of relative timing, VE(RT), which
Table 4.1. The Summary of Dependent Measures

<table>
<thead>
<tr>
<th>Dependent Measures</th>
<th>Aspects of Performance Assessed</th>
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<tr>
<td>The number of excluded trials</td>
<td>Trials excluded from analyses of the other dependent measures</td>
</tr>
<tr>
<td>RMS error: Root mean square error</td>
<td>General performance reflecting average spatio-temporal deviations from the goal movement pattern</td>
</tr>
<tr>
<td>ICEI(RT): Absolute constant error of relative timing</td>
<td>Accuracy of the relative timing structure of GMP</td>
</tr>
<tr>
<td>VE(RT): Variable error of relative timing</td>
<td>Consistency of the relative timing structure of GMP</td>
</tr>
<tr>
<td>ICEI(OD): Absolute constant error of overall duration</td>
<td>Accuracy of overall duration parameter modifications</td>
</tr>
<tr>
<td>VE(OD): Variable error of overall duration</td>
<td>Consistency of overall duration parameter modifications</td>
</tr>
<tr>
<td>ICEI(RAAA): Absolute constant error of relative average angular acceleration</td>
<td>Accuracy of the relative force structure of GMP</td>
</tr>
<tr>
<td>VE(RAAA): Variable error of relative average angular acceleration</td>
<td>Consistency of the relative force structure of GMP</td>
</tr>
<tr>
<td>ICEI(OAAA): Absolute constant error of overall average angular acceleration</td>
<td>Accuracy of overall force parameter modifications</td>
</tr>
<tr>
<td>VE(OAAA): Variable error of overall average angular acceleration</td>
<td>Consistency of overall force parameter modifications</td>
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</table>
assessed the proportional consistency of the relative timing structure. It was derived by calculating VE for the observed MT proportions for each segment of each task variation. The fifth and six dependent measures were related to overall duration parameter learning. The fifth dependent measure, ICEl(OD), assessed the accuracy of overall duration parameter modifications. It was derived by calculating ICEl for the differences between the observed total MT and the goal total MT for each task variation. The sixth dependent measure, VE(OD), assessed the consistency of overall duration parameter modifications. It was derived based on the observed total MT for each task variation.

The seventh and eighth dependent measures were related to GMP learning in terms of force characteristics. For the initial calculation of these measures, angular acceleration for each data point was calculated based on the filtered angular displacement data. Then, absolute values of angular acceleration were averaged across data points for each movement segment. Absolute values of angular acceleration were used to prevent negative values of angular acceleration (i.e., deceleration) from canceling out positive values of angular acceleration. This average angular acceleration provided an index of the net torque produced for each movement segment. Based on the average angular acceleration for each segment, it was then possible to calculate the seventh dependent measure, ICEl(RAAA), which assessed the proportional accuracy of relative average angular acceleration. It was derived by calculating ICEl for the differences between the observed and goal average angular acceleration proportions for each segment of each task variation. The eighth dependent measure, VE(RAAA) which assessed the consistency of relative average angular acceleration, was also derived based on the observed average angular acceleration proportions for each segment of each task variation.

The last two dependent measures were related to overall force parameter learning. For the initial calculation of these measures, absolute values of angular acceleration were averaged over the period of total MT for each task variation. This overall average angular acceleration provided an index of the overall amount of torque produced for each task.
variation. It was then possible to calculate the ninth dependent measure, \( \text{ICE}(\text{OAAA}) \), which assessed the accuracy of overall average angular acceleration. It was derived by calculating \( |\text{ICE}| \) for the differences between the observed and goal overall average angular acceleration for each task variation. The last dependent measure, \( \text{VE}(\text{OAAA}) \), which assessed the consistency of overall average angular acceleration, was also derived by calculating \( \text{VE} \) for the observed overall average angular acceleration for each task variation.

For statistical analyses, the number of excluded trials, RMS error, \( \text{ICE}(\text{OD}) \), \( \text{VE}(\text{OD}) \), \( \text{ICE}(\text{OAAA}) \) and \( \text{VE}(\text{OAAA}) \) were averaged across the task variations, and \( \text{ICE}(\text{RT}) \), \( \text{VE}(\text{RT}) \), \( \text{ICE}(\text{RAAA}) \) and \( \text{VE}(\text{RAAA}) \) were averaged across the movement segments and the task variations. For acquisition data, separate 2 x 3 x 2 (Acquisition Condition x Session x Trial Block) ANOVAs with repeated measures on the last two factors were used for each dependent measure. The two trial blocks used in these analyses were the first and the last trial blocks from each acquisition session. Thus, the trial blocks 1 and 2 from the first session, the trial blocks 1 and 4 from the second session, and the trial blocks 1 and 6 from the third session were analyzed in the ANOVA. For retention and transfer data, separate 2 x 2 x 3 (Acquisition Condition x Test Condition x Session) ANOVAs with repeated measures on the last factor were used for each dependent measure. Degrees of freedom for repeated measures were adjusted when sphericity assumption was violated according to the Greenhouse-Geisser epsilon values (Greenhouse & Geisser, 1959). All post hoc analyses were done with the Tukey’s honestly significant difference (HSD) test. In all analyses, the rejection region was \( p < .05 \).
Results

The Number of Excluded Trials

Acquisition

The analysis of the number of excluded trials in acquisition revealed no significant main effects or interactions. No subject had more than 3 excluded trials in any trial block in acquisition and the number of excluded trials was not different for the blocked and serial acquisition groups. The blocked acquisition condition had the number of excluded trials of $M = .18$, $SD = .26$ in session 1, $M = .11$, $SD = .16$ in session 2, and $M = .06$, $SD = .16$ in session 3. The blocked acquisition condition had $M = .07$, $SD = .17$ in session 1, $M = .07$, $SD = .22$ in session 2, and $M = .08$, $SD = .23$ in session 3.

Retention

The ANOVA revealed no significant main effects or interactions. No subject had more than 2 excluded trials in any trial block in retention. For the blocked acquisition condition, the number of excluded trials during retention was $M = .00$, $SD = .00$ in session 1, $M = .06$, $SD = .13$ in session 2, and $M = .06$, $SD = .13$ in session 3. The serial acquisition condition had $M = .03$, $SD = .10$ in session 1, $M = .00$, $SD = .00$ in session 2, and $M = .03$, $SD = .10$ in session 3.

Transfer

No subject had more than 2 excluded trials in any trial block in transfer and the ANOVA revealed no significant main effects or interactions. The blocked acquisition condition had $M = .11$, $SD = .30$ in session 1, $M = .11$, $SD = .22$ in session 2, and $M = .03$, $SD = .10$ in session 3. The serial acquisition condition had $M = .00$, $SD = .00$ in sessions 1 and 2, and $M = .03$, $SD = .10$ in session 3.

General Performance

Acquisition

Figure 4.2 shows the RMS error in the three acquisition, retention and transfer sessions. The analysis of the RMS error in acquisition revealed a significant main effects
Figure 4.2. Mean root mean square error during three acquisition, retention and transfer sessions.
for Session, $F(1.6, 35.9) = 55.11, p < .001$, and Trial Block, $F(1, 22) = 43.17, p < .001$. Although the ANOVA also revealed a significant interaction for Session x Trial Block, $F(2.0, 43.7) = 3.49, p < .05$, the post hoc test showed that the RMS error significantly decreased from the first to the last trial block in all acquisition sessions. All other main effects or interactions were not significant.

**Retention**

The analysis of the RMS error in retention revealed a significant main effect for Acquisition Condition, $F(1, 20) = 11.89, p < .01$, with the serial acquisition condition ($M = 8.54^*, SD = 2.38^*$) having less RMS error than the blocked acquisition condition ($M = 10.29^*, SD = 2.22^*$). The ANOVA also revealed a significant main effect for Session, $F(2.0, 39.4) = 21.74, p < .001$. The post hoc test showed that the RMS error decreased from session 1 to session 2 and from session 2 to session 3. Because all other main effects or interactions were not significant, the amount of practice did not influence the CI effect in retention.

**Transfer**

The ANOVA revealed a significant main effect for Acquisition Condition, $F(1, 20) = 6.95, p < .05$, with the serial acquisition condition ($M = 10.11^*, SD = 3.57^*$) showing less RMS error than the blocked acquisition condition ($M = 12.41^*, SD = 3.63^*$). A main effect for Session, $F(1.9, 38.4) = 13.87, p < .001$, was also significant. The post hoc test revealed a significant improvement from session 1 to session 2 as well as from session 2 to session 3. All other main effects or interactions were not significant, indicating that the CI effect was found in all transfer test sessions.

**Accuracy of Relative Timing**

**Acquisition**

The analysis of ICEI(RT) in acquisition showed no significant main effects or interactions.
Retention

The ANOVA for ICEI(RT) in retention revealed a significant interaction for Session x Test Condition, $F(1.9, 38.9) = 5.11$, $p < .05$. The post hoc test showed that under the serial retention test condition ICEI(RT) significantly decreased from session 1 ($M = 8.7\%, \ SD = 2.1\%$) to session 2 ($M = 7.2\%, \ SD = 1.7\%$). No other main effects or interactions were significant.

Transfer

The ANOVA for ICEI(RT) in transfer showed no significant main effects or interactions.

Consistency of Relative Timing

Acquisition

The analysis of VE(RT) in acquisition revealed a significant main effect for Session, $F(1.9, 41.1) = 4.34$, $p < .05$. The post hoc test showed that VE(RT) was significantly smaller for session 3 than session 1. There was also a significant main effect for Trial Block, $F(1, 22) = 9.05$, $p < .01$, as VE(RT) decreased from the first to the last trial block. No other main effects or interactions were significant.

Retention

The analysis of VE(RT) in retention showed no significant main effects or interactions.

Transfer

The ANOVA revealed a significant main effect only for Acquisition Condition, $F(1, 20) = 4.38$, $p < .05$, with the serial acquisition condition ($M = 1.9\%, \ SD = .6\%$) having less VE(RT) than the blocked acquisition condition ($M = 2.4\%, \ SD = .7\%$). Thus, the CI effect was found in the consistency of relative timing in transfer. All other main effects or interactions were not significant.
Accuracy of Overall Duration

Acquisition

Figure 4.3 shows ICEI(OD) in the three acquisition, retention and transfer sessions. The analysis of ICEI(OD) revealed a significant main effect for Session, $F(1.8, 40.6) = 16.46, p < .001$. The post hoc test showed that although session 3 did not differ from session 2, there was a significant improvement from session 1 to both sessions 2 and 3. A main effect for Trial Block, $F(1, 22) = 9.42, p < .01$, was also significant as the last trial block had less ICEI(OD) than the first trial block. There were no other significant main effects or interactions.

Retention

The ANOVA revealed a significant main effect for Acquisition Condition, $F(1, 20) = 5.12, p < .05$, with the serial acquisition condition ($M = 227 \text{ ms}, SD = 142 \text{ ms}$) having less ICEI(OD) than the blocked acquisition condition ($M = 311 \text{ ms}, SD = 167 \text{ ms}$). The ANOVA also revealed a significant main effect for Session, $F(1.4, 27.0) = 8.53, p < .01$, with the post hoc test showing that session 3 was better than session 2 which was also better than session 1. Because no other main effects or interactions were significant, the CI effect was found in all retention test sessions.

Transfer

The ANOVA revealed a significant main effect for Acquisition Condition, $F(1, 20) = 4.79, p < .05$. Because the serial acquisition condition ($M = 259 \text{ ms}, SD = 139 \text{ ms}$) led to less ICEI(OD) than the blocked acquisition condition ($M = 369 \text{ ms}, SD = 248 \text{ ms}$), the CI effect was again found in transfer. Although the ANOVA also revealed a significant main effect for Session, $F(1.8, 36.6) = 5.41, p < .05$, an interaction for Session x Test Condition, $F(1.8, 36.6) = 3.66, p < .05$, was also significant. The post hoc test revealed that under the blocked transfer test condition both sessions 2 and 3 were better than session 1, whereas under the serial transfer test condition only session 3 was
Figure 4.3. Mean absolute constant error of overall duration during three acquisition, retention and transfer sessions.
better than session 2. Because all other main effects or interactions were not significant, the amount of practice did not influence the efficacy of the CI effect in transfer.

**Consistency of Overall Duration**

**Acquisition**

The ANOVA for VE(OD) in acquisition revealed significant main effects for Session, \( F(2.0, 43.7) = 19.18, p < .001 \), and Trial Block, \( F(1, 22) = 38.38, p < .001 \). The ANOVA also revealed significant interactions for Acquisition Condition x Session, \( F(2.0, 43.7) = 3.68, p < .05 \), and Session x Trial Block, \( F(1.9, 41.6) = 4.22, p < .05 \). The post hoc test for the Acquisition Condition x Session interaction showed that in session 3 the serial acquisition condition (M = 111 ms, SD = 36 ms) had less VE(OD) than the blocked acquisition condition (M = 142 ms, SD = 47 ms), but no significant differences due to the acquisition conditions were found in sessions 1 and 2. The post hoc test for the Session x Trial Block interaction showed that the last trial block was better than the first trial block only in sessions 1 and 3. There were no other significant main effects or interactions.

**Retention**

The analysis of VE(OD) in retention revealed a significant main effect for Acquisition Condition, \( F(1, 20) = 15.86, p < .001 \), with the serial acquisition condition (M = 109 ms, SD = 36 ms) having less VE(OD) than the blocked acquisition condition (M = 152 ms, SD = 63 ms). The ANOVA also revealed a significant main effect for Test Condition, \( F(1, 20) = 11.92, p < .01 \), with the blocked retention test (M = 112 ms, SD = 39 ms) leading to less VE(OD) than the serial retention test (M = 150 ms, SD = 64 ms). In addition, a main effect for Session, \( F(1.7, 33.2) = 3.58, p < .05 \), was significant. The post hoc test showed that session 3 was better than sessions 1 and 2 though session 2 was not significantly better than session 1. Because no interactions were significant, the CI effect was found in all retention test sessions.
Transfer

The analysis of VE(OD) in transfer revealed a significant main effect only for Acquisition Condition, $F(1, 20) = 5.66, p < .05$, as the serial acquisition condition ($M = 90\text{ ms, SD} = 31\text{ ms}$) led to the better consistency than the blocked acquisition condition ($M = 117\text{ ms, SD} = 52\text{ ms}$). There were no other significant main effects or interactions, indicating that the CI effect in transfer was not influenced by the amount of practice.

Accuracy of Relative Average Angular Acceleration

Acquisition

The analysis of ICEI(RAAA) revealed significant main effects for Session, $F(1.7, 38.1) = 17.06, p < .001$, and Trial Block, $F(1, 22) = 9.27, p < .01$. The post hoc test showed that session 1 had larger ICEI(RAAA) than sessions 2 and 3, which were not different from each other. The last trial block had less ICEI(RAAA) than the first trial block. There were no other significant main effects or interactions.

Retention

The ANOVA showed only a significant main effect for Session, $F(1.7, 34.6) = 9.32, p < .001$. The post hoc test showed that although both sessions 2 and 3 had less ICEI(RAAA) than session 1, session 3 was not different from session 2. All other main effects or interactions were not significant.

Transfer

The transfer results replicated the retention results as there was only a significant main effect for Session, $F(1.8, 35.1) = 8.34, p < .001$. A significant improvement in ICEI(RAAA) was evident from session 1 to both sessions 2 and 3, though no significant difference was found between sessions 2 and 3.

Consistency of Relative Average Angular Acceleration

Acquisition

The analysis of VE(RAAA) in acquisition revealed significant main effects for Session, $F(2.0, 43.1) = 7.65, p < .01$, and Trial Block, $F(1, 22) = 5.55, p < .05$. The
post hoc test showed that VE(RAAA) significantly decreased from session 1 to session 2 as well as from session 2 to session 3. The last trial block had less VE(RAAA) than the first trial block. There were no other main effects or interactions.

Retention

The ANOVA for VE(RAAA) in retention revealed no significant main effects or interactions.

Transfer

The ANOVA for VE(RAAA) in transfer revealed only a significant interaction for Session x Test Condition, $F(2.0, 39.0) = 3.79, p < .05$. The post hoc test showed that under the serial transfer test condition VE(RAAA) was greater for session 2 compared to sessions 1 and 3, while under the blocked transfer test condition no differences were found among all sessions. No other significant main effects or interactions were significant.

Accuracy of Overall Average Angular Acceleration

Acquisition

Figure 4.4 shows lCEI(OAAA) in the three acquisition, retention and transfer sessions. The ANOVA for acquisition revealed a significant main effect for Session, $F(1.8, 40.7) = 4.88, p < .05$. The post hoc test showed a significant improvement only from session 1 to session 3. Although there was also a significant main effect for Trial Block, $F(1, 22) = 16.52, p < .001$, an interaction for Acquisition Condition x Trial Block, $F(1, 22) = 4.90, p < .05$, was significant. The post hoc test showed a significant improvement from the first to the last trial block only for the blocked acquisition condition.

Retention

The analysis of lCEI(OAAA) revealed a significant main effect for Acquisition Condition, $F(1, 20) = 6.29, p < .05$, with the serial acquisition condition ($M = 153.15 \text{ deg/s}^2, SD = 76.47 \text{ deg/s}^2$) leading to less lCEI(OAAA) in retention compared to the
Figure 4.4. Mean absolute constant error of overall average angular acceleration during three acquisition, retention and transfer sessions.
blocked acquisition condition ($M = 219.73$ deg/s$^2$, $SD = 102.85$ deg/s$^2$). The ANOVA also revealed a significant main effect for Session, $F(1.6, 31.7) = 7.13$, $p < .01$. The post hoc test showed that there was a significant improvement from session 1 to both sessions 2 and 3, which were not different from each other. Because all other main effects or interactions were not significant, the Cl effect was found in all retention test sessions.

**Transfer**

The transfer results paralleled with the retention results as there were significant main effects for Acquisition Condition, $F(1, 20) = 4.69$, $p < .05$, and Session, $F(1.9, 38.1) = 4.97$, $p < .05$. The serial acquisition condition ($M = 277.03$ deg/s$^2$, $SD = 97.30$ deg/s$^2$) led to less ICEI(OAAA) in transfer than the blocked acquisition condition ($M = 328.64$ deg/s$^2$, $SD = 105.54$ deg/s$^2$). There were no other significant main effects or interactions, indicating that the Cl effect in transfer was not influenced by the amount of practice.

**Consistency of Overall Average Angular Acceleration**

**Acquisition**

The analysis of VE(OAAA) showed a significant main effect only for Trial Block, $F(1, 22) = 6.35$, $p < .05$, indicating a significant improvement from the first to the last trial block. All other main effects or interactions were not significant.

**Retention**

The ANOVA for VE(OAAA) in retention showed no significant main effects or interactions.

**Transfer**

The ANOVA for VE(OAAA) in transfer also showed no significant main effects or interactions.
Discussion

The purpose of this experiment was to clarify inconsistent findings in the research literature concerning the Cl effect when task variations are controlled by the same GMP. The first issue addressed was the interaction between the amount of practice and the efficacy of the Cl effect. In this experiment, the general performance measure showed a strong Cl effect in both retention and transfer. The serial acquisition condition led to the better retention and transfer performance than the blocked acquisition condition. Although there was a tendency for the efficacy of the Cl effect in both retention and transfer to increase as the amount of practice increased, the interaction between the amount of practice and the Cl effect was not statistically significant. It therefore must be concluded that the amount of practice did not influence the Cl effect found for the general performance. These results are contrary to those reported by C. H. Shea et al. (1990) because the Cl effect was found even after a relatively small number of acquisition trials (i.e., 60).

The lack of the interaction between the amount of practice and the Cl effect suggests that the reason for failing to find the Cl effect in many previous studies with the same GMP task variations (Heitman & Gilley, 1989; Lee et al., 1992; Turnbull & Dickinson, 1986; Whitehurst & Del Rey, 1983; Wulf, 1992; Wulf & Lee, 1993) may not be attributed to the amount of practice used or the nature of the tasks as it relates to the GMP characteristics. Rather, it is possible that in these studies the Cl effect did not occur because of other possible influences, such as subject characteristics, task characteristics other than the GMP structure, and characteristics of experimental procedures other than the amount of practice (Magill & Hall, 1990).

Although the results of the general performance showed the Cl effect regardless of the amount of practice, it is necessary to dissociate the measures assessing GMP learning from measures assessing parameter learning to investigate which type of learning was responsible for the Cl effect found for the general performance measure. The
dissociated measures also allowed us to clarify the inconsistency among the previous findings concerning these two types of learning. With the dissociation measurement technique, the general performance was decomposed into eight different aspects of performance. There were four measures of GMP learning which separately assessed the accuracy and consistency of the relative timing structure and the accuracy and consistency of the relative force structure. There were also four measures of parameter learning which separately assessed the accuracy and consistency of the overall duration parameter and the accuracy and consistency of the overall force parameter.

The analyses of these dissociated measures revealed that all aspects of performance improved during acquisition, except for the accuracy of relative timing. However, the consistency of relative timing improved throughout practice. These results showed that both GMP structures and parameter modifications for both timing and force characteristics improved with practice.

All measures related to GMP learning showed no CI effect in either retention or transfer, except for the consistency of relative timing in transfer. That GMP learning is unlikely to be enhanced by high CI practice when task variations are controlled by the same GMP is consistent with previous results (Sekiya et al., 1994, 1995). As argued by Sekiya et al., and consistent with Magill and Hall (1990), because task variations controlled by the same GMP share the same invariant features, reconstruction of the GMP structures is not necessary from trial to trial even under high CI practice. If high CI practice does not require an effortful processing of GMP reconstruction, facilitation of GMP learning should not be predicted. Thus, when the same invariant features underlie all task variations, the processing demand for GMP reconstruction required under high CI practice is same as that required under low CI practice, resulting in no CI effect for that aspect of learning.

Although most measures of GMP learning did not show the CI effect, it should be noted that the CI effect was found with the consistency of relative timing in transfer. This
suggests that GMP learning may be enhanced by high CI practice, which is consistent with the results of Wulf and Lee (1993). They showed that high CI practice led to a better relative timing structure in transfer than did low CI practice. One possible reason for this beneficial effect is that high CI practice may allow subjects to better abstract the GMP structures which are common among all task variations (Wulf & Lee, 1993). However, this effect may in fact be a spurious finding given that all other measures assessing GMP learning showed that GMP learning is not enhanced by high CI practice when the same GMP task variations are learned.

For parameter learning, all measures, except for the measure assessing the consistency of overall force parameter modifications, showed the CI effect in both retention and transfer. That one measure related to the overall force parameter did not show the CI effect is consistent with Sekiya et al.'s (1995) finding that the CI effect was produced only for the accuracy, but not the consistency, of overall force parameter modifications. Because all but one of the measures assessing parameter learning produced the CI effect, the results of this study are consistent with the results of the previous studies (Sekiya et al., 1994, 1995) where the CI effect was found in parameter learning of task variations controlled by the same GMP. As argued by Sekiya et al., and contrary to Magiil and Hall (1990), when the same GMP task variations are practiced, parameter modification from one trial to another is influenced to a greater extent under high CI practice than by low CI practice. The more effortful processing required under high CI practice is considered to subsequently facilitate retention and transfer. Furthermore, when the findings from the measures of GMP learning and parameter learning are taken together, the CI effect found for the general performance was attributed to the CI effect found for the measures of parameter learning, replicating the previous findings (Sekiya et al., 1994, 1995). As a whole, it is reasonable to conclude that whatever aspect of the task is changed from trial to trial it is the source of CI and a beneficial effect on learning should be limited to that aspect of the task.
Although the predicted interaction between the amount of practice and the CI effect was not found in the present experiment, two related predictions based on C. H. Shea et al. (1990) concerning GMP learning and parameter learning can be examined with the analyses of the dissociated measures. The first prediction, that in early practice GMP learning would be enhanced by low CI practice, was not supported in the present experiment because no advantage for low CI practice was shown for measures of GMP learning after a relatively small amount of practice. The second prediction, that parameter learning would be enhanced by high CI practice only in later practice, also was not supported because parameter learning was enhanced by high CI practice even in early practice. Furthermore, the C. H. Shea et al. (1990) hierarchical perspective of GMP and parameter learning was not supported by the results of acquisition performance in this study. Contrary to their view, where subjects in early practice focus their attention to the fundamental GMP structures but shift their focus to parameter learning as they acquire the GMP structures with practice, dissociated measures in early practice showed that both GMP structures and parameter modifications improved with practice. These results suggest that subjects in early practice paid attention to both GMP and parameter components of the task. The fact that parameter modifications improved from the beginning of practice suggests that parameter learning does not necessarily have to wait the perfection of a GMP structure. Simultaneous improvements of both GMP structures and parameter modifications suggest that GMP learning does not precede parameter learning and vice versa. Because parameter modifications can be sources of interference even in early practice, the CI effect can be produced in the process of parameter learning even after a small amount of practice, as it was clearly shown in this study.

The second purpose of the present study was to investigate the compatibility of retention and transfer findings, because there have been inconsistent findings with regard to GMP learning and parameter learning in retention and transfer tests (Sekiya et al., 1994, 1995; Wulf & Lee, 1993). In the present study, all measures that showed the CI
effect in retention also showed the CI effect in transfer. The only exception was that the CI effect for the consistency of the relative timing was found in transfer but not in retention. Therefore, the retention results were generally compatible with the transfer results. In terms of the inconsistent findings reported in the CI literature, the results in this experiment are consistent with the retention findings of Sekiya et al.'s (1994, 1995) studies that parameter learning but not GMP learning is enhanced by high CI practice when the same GMP task variations are learned. Additionally, the Sekiya et al. results not only were replicated in this experiment, they were extended by including the transfer aspect of learning.

Although Wulf and Lee (1993) argued that the beneficial effect of high CI practice on GMP learning is canceled out by the detrimental effect of high CI practice on parameter learning, this notion was not supported by the results of the present study. Furthermore, although Wulf and Lee also argued that high CI practice makes subjects pay more attention to invariant features of the GMP relative to parameter modifications and hence degrades parameter learning, the results of the present study clearly contradict this notion because parameter learning was actually enhanced by high CI practice. Wulf and Lee derived these arguments based on their findings that the beneficial effect on GMP learning for high CI practice was found only in a delayed transfer test and the detrimental effect on parameter learning for high CI practice was found only in an immediate transfer test. In addition, no difference due to practice schedules was found in retention for both types of learning. It now appears that their arguments were developed based on unreliable results and therefore were not supported by a series of experiments (Sekiya et al., 1994, 1995) including the present study where parameter learning, but not GMP learning, was enhanced by high CI practice.

Additionally, the fact that the retention results paralleled the transfer results in this study indicates that the same underlying process is responsible for the CI effect in both retention and transfer tests. Because task variations used in the retention and transfer
tests shared the same GMP structure, all task variations could be performed by modifying parameters of the same GMP. The findings of this study is consistent with the prediction derived from Schmidt's (1975) schema theory that effects of practice schedule manipulations would influence the retention and transfer aspects of learning in a similar way, because only one abstract memory representation is the basis for both retention and transfer performance. However, the present findings should be limited to transfer situations where task variations require only parameter modifications of the GMP that is learned during practice. Transfer to task variations that have different GMP structures awaits further research.

Finally, regarding the last purpose of the present experiment, which was to consider the CI effect when task variations required simultaneous modifications of both timing and force parameters of the same GMP, the results indicated that modifying both parameters created the CI effect for both timing and force parameters. This effect was shown by the measures assessing overall duration parameter modifications and overall force parameter modifications. Because both timing and force parameters were modified from one trial to another, different practice schedules created different levels of CI in both aspects of parameter modifications. It should be noted that when only force parameter modifications were required in the study by Sekiya et al. (1995), no CI effect was found for timing characteristics because all task variations shared the same relative timing and the same overall duration. When this finding and the findings of the present study are taken together, it can be concluded that parameters modified from trial to trial are the sources of different levels of CI and the CI effect should be predicted to occur for the learning process of those parameters.

References for Chapter 4


Notes for Chapter 4

\[
\text{RMS error} = \sqrt{\frac{\sum_{t=1}^{n} (GAD_t - SAD_t)^2}{n}}
\]

where \(GAD_t = \text{goal angular displacement at moment } t\), \(SAD_t = \text{subject's angular displacement at moment } t\), and \(n = \text{number of data points}\).
It was assumed that the average angular acceleration for each movement segment reflected the net torque produced for each movement segment, because the mass moment of inertia about the elbow joint was constant within a subject throughout the experiment. Applying Newton's second law of motion (F = ma) to an angular motion, torque is a product of moment of inertia and angular acceleration, indicating that torque is proportional to angular acceleration when moment of inertia is constant. Also, this assumption is supported by the fact that the impulse for acceleration, which is the area under the time-acceleration curve, is commonly used as an index of the amount of force (Carlton & Newell, 1993). In the present experiment, the impulse for angular acceleration would correspond to this measure. The average angular acceleration used in the present experiment is similar to this measure but has an advantage in that the amount of torque is standardized by time to dissociate measures related to torque characteristics from measures related to timing characteristics.
CHAPTER 5: GENERAL DISCUSSION

The purposes of this dissertation were to investigate the generalizability of the contextual interference (CI) effect in terms of task characteristics, the amount of practice, and types of learning tests. The results of the four experiments presented in this dissertation indicate that the CI effect is a robust phenomenon that can be found regardless of manipulations of these factors. Although there have been hypotheses that proposed limitations to the generalizability of the CI effect with regard to task characteristics (Magill & Hall, 1990) and the amount of practice (C. H. Shea, Kohl & Indermill, 1990), the present findings provide evidence that the CI effect is generalizable to more various situations beyond the limitations derived from these hypotheses.

The Magill and Hall (1990) hypothesis, that the CI effect would be found when task variations controlled by different GMPs were learned but is unlikely to be found when task variations controlled by the same GMP are learned, was tested by Experiments 1 and 2 (Sekiya, Magill, Sidaway & Anderson, 1994). In these experiments, both types of task variations were used so that a lack of the CI effect in one of the experiments could be attributed solely to the GMP characteristics of task variations. The results showed that the CI effect was found regardless of task variations, contrary to the Magill and Hall hypothesis. Although the results from Experiment 1 are consistent with the first part of the hypothesis, it is less meaningful if the second part of the hypothesis is not supported because one part of the hypothesis was defined relative to the other part of the hypothesis. The second part of the hypothesis was not supported by the results of Experiment 2 because the CI effect was produced when task variations controlled by the same GMP were learned. This finding from Experiment 2, which is consistent with some previous studies (Carnahan, van Eerd & Allard, 1990; Young, Cohen & Husak, 1993) but contrary to the others (Lee, Wulf & Schmidt, 1992; Wulf & Lee, 1993), was replicated by the results of Experiments 3 (Sekiya, Magill & Anderson, 1995) and 4, in which different numbers and types of parameters of the same GMP were modified. Thus, the
series of experiments in this dissertation provide evidence that the CI effect can be found regardless of GMP structures of task variations contrary to the Magill and Hall hypothesis.

One reason for the CI effect to be found regardless of task characteristics is that both GMP learning and parameter learning can be sources of different levels of CI to produce the CI effect. When the findings with the dissociated measures of GMP learning and parameter learning in all experiments are taken together, there is a solid tendency toward that the CI effect is created for aspects of performance that change from trial to trial under high CI practice. When task variations required both GMP reconstruction and parameter modifications under high CI practice, parameter learning was enhanced by high CI practice and a tendency toward an enhancement of GMP learning was also observed for high CI practice though it failed to be statistically significant (Experiment 1). On the other hand, when task variations required only parameter modifications under high CI practice, only parameter learning was enhanced by high CI practice (Experiments 2, 3 and 4). Thus, the dissociated measures of GMP and parameter learning provide evidence against the basis of the Magill and Hall (1990) hypothesis that parameter modifications of the same GMP do not create sufficient interference to promote the level of processing that is considered to facilitate learning. Additionally, in all experiments these enhanced aspects of performance were reflected in the measure of general performance that is sensitive to all aspects of performance, indicating that the CI effect is predicted to occur even if only part of the task creates different levels of CI under different practice schedules.

The notion that the CI effect is localized in aspects of performance that change from trial to trial under high CI practice is also supported by the results of dissociated parameter measures. Although the CI effect was found for the measure of general performance regardless of the number and types of parameters modified, the CI effect was attributed to the learning process of parameters that changed from trial to trial under
high Cl practice. When the overall duration parameter was modified under high Cl practice, overall duration parameter learning was enhanced by this practice schedule (Experiment 2). Although subjects in this experiment could have modified both overall duration and overall force parameters, whether overall force parameter learning produced the Cl effect was not determined because force characteristics were not measured. However, this issue was clarified by Experiment 4 where task variations required simultaneous modifications of the overall duration and overall force parameters of the same GMP and both timing and force characteristics were measured. The results of this experiment showed that the learning processes of both parameters produced the Cl effect. In contrast, when only the overall force parameter was modified under high Cl practice, only the learning process of this parameter produced the Cl effect, whereas no Cl effect was found for the learning process of the overall duration parameter (Experiment 3). Thus, learning of any parameter that is modified from one trial to another is enhanced by high Cl practice.

The findings from the series of experiments presented in this dissertation have implications for how the Cl effect occurs. The rationale of the Magill and Hall (1990) hypothesis, which was based on an action plan reconstruction hypothesis proposed by Lee and Magill (1983, 1985) to explain the Cl effect, is that modifications of parameters, which are only part of an action plan, do not create sufficient interference to facilitate learning. However, the findings from the experiments in this dissertation provide evidence that parameter modifications can create a sufficiently high level of Cl during acquisition to produce the Cl effect in parameter learning. One of the problems with the prediction of the Magill and Hall hypothesis is that the reconstruction of part versus all of an action plan was related to levels of Cl rather than sources of Cl. The levels of Cl refer to how much interference is created, whereas the sources of Cl refer to what aspects of performance have different levels of interference.
The present findings suggest that different levels of CI can be created by different practice schedules, such as blocked and serial practice, whereas there are different sources of CI, such as GMP reconstruction and parameter modifications. Types of task variations to be learned determine possible sources of different levels of CI. If task variations to be learned require both GMP reconstruction and parameter modifications, both processes of GMP reconstruction and parameter modifications can be sources of different levels of CI. This notion is supported by the findings from Experiment 1 that GMP learning produced the CI effect and parameter learning also showed a tendency toward an predicted CI effect when task variations required both GMP reconstruction and parameter modifications under high CI practice. In contrast, when task variations require only parameter modifications, only the process of parameter modifications can be a source of different levels of CI. This is also supported by the findings from Experiments 2, 3 and 4 because the CI effect was produced only in parameter learning when task variations required only parameter modifications under high CI practice. Therefore, the GMP structures of task variations should be related to sources of CI rather than levels of CI.

Furthermore, to derive valid predictions concerning the relationship between the CI effect and task characteristics, the action plan reconstruction hypothesis (Lee & Magill, 1983, 1985) should be extended to include the notion of sources of CI because as it stands the hypothesis explains the CI effect only from the levels of CI perspective. Another hypothesis proposed by J. B. Shea and his colleagues (J. B. Shea & Morgan, 1979; J. B. Shea & Zimny, 1983) to explain the CI effect is an elaboration hypothesis. In short, this hypothesis holds that under high CI practice, information about multiple task variations are simultaneously present in the working memory and more distinctive processing is required to distinguish one task variation from the others. This promoted level of elaboration is considered to enhance learning as assessed by retention and transfer performance. However, as is the case for the reconstruction view, the hypothesis
explains how different levels of CI are created but not what aspects of performance are the locus of the different levels of CI. Thus, the elaboration hypothesis also needs to be extended to incorporate the notion of sources of CI to localize different levels of CI in certain aspects of performance. Although both reconstruction and elaboration views need to incorporate the notion of sources of CI, the validity of both views about how different levels of CI are created were not addressed in this dissertation and awaits further research.

The generalizability of the CI effect in terms of the amount of practice was investigated by using different numbers of acquisition trials prior to learning tests. On the basis of the findings by C. H. Shea et al. (1990), it was predicted that the efficacy of the CI effect improves as the amount of practice increases. However, the results of Experiment 3 showed no interaction between the amount of practice and the efficacy of the CI effect. Experiment 4 extended the findings of Experiment 3 by involving a relatively small amount of practice, because two different amounts of practice used in Experiment 3 were considered large enough to produce the CI effect based on the between-study comparisons of the CI literature regarding task variations controlled by the same GMP. The results of Experiment 4 also found no influence of the amount of practice on the CI effect, though there was a non significant tendency for the efficacy of the CI effect to increase as the amount of practice increased for the general performance measure. These findings from both Experiments 3 and 4 are consistent with the study by Proteau, Blandin, Alain and Donion (1994), which found no influence of the amount of practice on the CI effect with task variations from different GMPs, suggesting that the interaction between the amount of practice and the CI effect, which was found by C. H. Shea et al., should not be attributed to characteristics of the GMP structures inherent in task variations used in their study.

The most significant finding concerning the amount of practice issue was that the CI effect was found even when task variations from the same GMP were learned with a
relatively small amount of practice. Therefore, the inconsistency among the previous findings with task variations controlled by the same GMP should not be attributed to either the GMP characteristics or the amount of practice. Rather, it is possible that the failure to find the CI effect with the same GMP task variations in some of the previous studies (Heitman & Gilley, 1989; Lee, Wulf & Schmidt, 1992; Turnbull & Dickinson, 1986; Whitehurst & Del Rey, 1983; Wulf, 1992; Wulf & Lee, 1993) might be due to other factors that prevent the occurrence of the CI effect. The possible factors include subject characteristics, such as cognitive styles and motivation levels of subjects. Jelsma and his colleagues (Jelsma & Pieters, 1989; Jelsma & Van Merrienboer, 1989) found that reflectivity and impulsivity of subject's cognitive style interacted with the CI effect and Chamberlin and Lee (1993) suggested that highly motivated subjects could eliminate the disadvantage of low CI practice. However, more research is necessary to investigate the factors, such as subject characteristics, that may influence the efficacy of the CI effect.

Although the interaction between the amount of practice and the efficacy of the CI effect was not found, two predictions derived from C. H. Shea et al.'s (1990) view concerning why the amount of practice should influence the CI effect could be tested by using the dissociation measurement technique used in all experiments. The first prediction that in early practice GMP learning is enhanced by low CI practice, was not supported because no difference due to practice schedules was found for GMP learning. The second prediction, that parameter learning is enhanced by high CI practice only in later practice, was also not supported because parameter learning was enhanced by high CI practice regardless of the amount of practice. The underlying rationale for these predictions was that subjects pay more attention to the fundamental GMP structures in early practice and their attention shifts from the GMP structures to parameter modifications as practice progresses. However, the results of the dissociated measures in all experiments showed simultaneous improvements of both GMP structures and
parameter modifications from the beginning of practice, suggesting that GMP learning does not precede parameter learning and vice versa.

Taken together, C. H. Shea et al.'s (1990) findings were not replicated by both Experiments 3 and 4 of this dissertation. Also, the rationale for predicting the influence of the amount of practice on the CI effect was not supported by the results from the dissociated measures of GMP and parameter learning in all experiments. Furthermore, the Magill and Hall hypothesis was not supported regardless of the amount of practice. Therefore, the findings in this dissertation extend the generalizability of the CI effect to situations where task variations requiring only parameter modifications are learned with a relatively small amount of practice.

The compatibility of the CI effects in retention and transfer tests regarding GMP and parameter learning was investigated in Experiment 4 by using both types of learning tests. The results of Experiment 4 showed that all CI effects found in retention were also found in transfer, suggesting that the same processes underlie retention and transfer aspects of learning at least in the CI paradigm. Furthermore, the retention and transfer findings in this experiment were consistent with the retention findings in Experiments 2 and 3 but contrary to the transfer findings by Wulf and Lee (1993), because only parameter learning was enhanced by high CI practice when task variations from the same GMP were learned. While the retention findings of Experiments 2 and 3 were replicated by both retention and transfer findings of Experiment 4, Wulf and Lee's argument that high CI practice enhances GMP learning but hinders parameter learning, which was based only on one experiment, was not supported by the series of these experiments in this dissertation. Therefore, it is concluded that parameter learning, but not GMP learning, is enhanced by high CI practice when task variations from the same GMP are learned and this should be reflected in the same fashion in both retention and transfer tests.
The findings of this dissertation have practical implications for real world motor learning situations. When motor skills that require different movement patterns are learned, learning of both coordination and control, which are defined as topological relationships in the body and limbs and scaling of the movement, respectively (Kugler, Kelso & Turvey, 1980), are predicted to be enhanced by high Cl practice. For example, when different tennis strokes, such as a serve, a forehand ground stroke, and a backhand ground stroke, are to be learned, coordinated movement patterns as well as scaling of the movements for these different strokes would be learned better under high Cl practice, such as random and serial practice, compared to low Cl practice, such as blocked practice. In contrast, when skills that require the same movement pattern but different overall scaling of the movement are to be learned, only the scaling aspect of learning is predicted to be enhanced by high Cl practice. An example of this situation would be when a tennis forehand ground stroke is hit with a variety of speeds but with the same motion, scaling factors, such as how much force to produce or how quickly a swing is completed, would be learned better under high Cl practice compared to low Cl practice. However, high Cl practice would be unlikely to have a beneficial effect on learning coordinated movement patterns as compared to low Cl practice. Thus, multiple motor skills learned under high Cl practice should be chosen to have either the same or different coordination structures depending on what aspects of performance need to be enhanced. Furthermore, when the scaling of the movement is to be learned, variations of a motor skill should be chosen to have scaling parameters that need to be enhanced.

Another implication for practical training is that high Cl practice can be beneficial for beginning learners even in early practice. This notion is supported by the fact that tasks used in the experiments of this dissertation were novel to subjects and the Cl effect was found at the stage where both coordination and control were being improved. Taken together with the findings from the study by Hall, Domingues and Cavazos (1994), in which the Cl effect was demonstrated with skilled baseball players, the beneficial learning
effect of high Cl practice seems to be generalizable to an wide range of learning stages. Furthermore, high Cl practice should be used in learning both closed and open motor skills. Learning closed skills, where a retention aspect of learning is more emphasized, and open skills, where a transfer aspect of learning is more emphasized, are predicted to produce the Cl effect because both retention and transfer aspects of learning produce the Cl effect.

In summary, the present dissertation investigated the generalizability of the Cl effect with regard to characteristics of task variations, the number and types of parameters of the GMP, the amount of practice, and types of learning tests. The results showed that learning task variations controlled by either the same or different GMPs can produce the Cl effect. Also, learning modifications of either the overall duration parameter, the overall force parameter or simultaneous modifications of both parameters can produce the Cl effect. These Cl effects can be expected to occur after a relatively small amount of practice as well as after a relatively large amount of practice. Additionally, high Cl practice is predicted to have beneficial effects on both retention and transfer aspects of learning. Based on these findings from the series of experiments in this dissertation, it is concluded that the Cl effect is a robust phenomenon, which is generalizable to a variety of motor learning situations. One reason for the Cl effect to be such a robust phenomenon is attributed to the fact that both GMP and parameter aspects of learning can produce the Cl effect. Therefore, it is strongly recommended that high Cl practice is used instead of low Cl practice to enhance motor skill learning.

References for Chapter 5


APPENDIX A: ADDITIONAL LITERATURE REVIEW

During the last two decades, many motor learning studies have focused on dissociating between temporary performance effects and relatively permanent learning effects. These studies have demonstrated some paradoxical phenomena whereby practice schedules that hinder acquisition performance actually facilitate learning as assessed by retention and transfer tests (See Chamberlin & Lee, 1993; Lee, Swinnen, & Serrien, 1994, for reviews). These phenomena have practical implications for real world motor learning situations because people tend to choose practice schedules that lead to the best performance during practice but have little concern for retention and transfer aspects of skill learning (Bjork, 1994).

One of the paradoxical phenomena is the contextual interference effect. This effect occurs when multiple tasks or variations of a task are practiced under conditions of high and low levels of contextual interference. Typically, random (high contextual interference) practice, where all tasks are practiced in an unsystematic order, leads to inferior acquisition performance but superior retention and/or transfer performance compared to blocked (low contextual interference) practice, where one task is repeatedly practiced before practice of another task begins. The contextual interference effect was first found in the motor domain by J. B. Shea and Morgan (1979) and many studies have replicated their findings with a variety of skills, types of learners and experimental procedures (See Chamberlin & Lee, 1993; Magill & Hall, 1990, for reviews).

Although the contextual interference effect is a robust phenomenon in the motor learning literature, Chamberlin and Lee (1993) and Magill and Hall (1990) have proposed that the contextual interference effect is not found in all motor learning situations but its efficacy interacts with characteristics of tasks, subjects and experimental procedures used. Based on the results of the previous studies, they discussed how these characteristics determine the generalizability of the contextual interference effect. However, the
influence of each of these characteristics on the contextual interference effect was examined separately from each other and interactive influences were paid little attention.

This single factor approach to the generalizability of the contextual interference effect is well represented by a hypothesis proposed by Magill and Hall (1990) concerning the task characteristics. They hypothesized that the contextual interference effect would be found when task variations are controlled by different generalized motor programs (GMPs), but should not be found when task variations are controlled by the same GMP. The hypothesis has intrigued researchers of contextual interference and has been cited in many studies (e.g., Chamberlin & Lee, 1993). Contrary to the hypothesis, however, some recent studies have demonstrated the contextual interference effect with task variations controlled by the same GMP (e.g., Sekiya, Magill, Sidaway & Anderson, 1994). It is therefore questionable whether the same vs. different GMP contrast is such a critical single factor that determines the occurrence of the contextual interference effect. Because inconsistent findings in the contextual interference research can not be clarified by the single factor approach, it is suggested that more than one factor interactively influence the contextual interference effect. Therefore, the interactive influences of several factors on the contextual interference effect need to be investigated. One possible interaction proposed in this paper is the interaction between the task characteristics in terms of the GMP structures and the amount of practice as it relates to stages of learning.

The first purpose of the present review is to update and reexamine the Magill and Hall (1990) hypothesis by reviewing studies that address this hypothesis. The second purpose is to propose an alternative hypothesis which considers the interactive influence of task characteristics and the amount of practice on the contextual interference effect. To accomplish these purposes, the present review is organized in the following way. First, the contextual interference effect is defined and a brief history of the contextual interference research is introduced. Then, studies related to the Magill and Hall hypothesis concerning the GMP characteristics are reviewed. Third, an alternative
hypothesis concerning the interactive influence of OMP characteristics and the amount of
practice on the contextual interference effect is proposed. Then, how the interaction of
these factors relate to already existing hypotheses proposed to explain the contextual
interference effect is discussed. Finally, directions for future research are discussed.

Definition of the Contextual Interference Effect

To establish a common base for reviewing the extensive amount of contextual
interference literature, it is necessary to define the contextual interference effect. The term
'contextual interference' refers to interference caused by practice schedules, such as
practice order and interpolated activities (Magill & Hall, 1990). For example, random
practice, where several tasks are practiced in an unsystematic order, is considered to
create a high level of contextual interference. In contrast, blocked practice, where all
practice trials on one task is completed before another task is practiced, is considered to
create a low level of contextual interference. Typically, high contextual interference
practice leads to inferior acquisition performance but superior retention and/or transfer
performance compared to low contextual interference practice.

Although all of these different effects on acquisition, retention and transfer
typically characterize the contextual interference effect, differences in retention and
transfer, which is caused by different levels of contextual interference during acquisition,
are the most important. This is because acquisition performance reflects temporary
performance effects, whereas retention and transfer performance reflects relatively
permanent learning effects (Chamberlin & Lee, 1993). In addition, although the reversal
of the performance levels of high and low contextual interference groups from acquisition
to retention or transfer is one characteristic of the contextual interference effect, it is not as
important as the absolute difference between groups in retention or transfer because
assessing transition from acquisition to retention or transfer confounds performance
effects and learning effects. Therefore, the contextual interference effect is defined in this
study as the learning advantage for high contextual interference practice, which is observed in retention and transfer tests.

A Brief History of Contextual Interference Research

Contextual interference research originated in the verbal domain, when Battig (1972) found that intratask interference during learning lists of words facilitated retention and transfer. Intratask interference, which was created by presentation order of the word lists, was later called contextual interference (Battig, 1979). Battig’s work cast doubt on the commonly held notion at the time that interference is always detrimental to learning. Battig’s (1972, 1979) notion that interference can be detrimental to acquisition but beneficial to learning was first examined in the motor domain by J. B. Shea and Morgan (1979). They had subjects learn to knock down small, wooden barriers with one hand as quickly as possible in three different spatial patterns under either a blocked or random order. Following acquisition trials, retention and transfer tests were administered. The results confirmed Battig’s notion as the subjects with random practice had inferior acquisition performance but superior retention and transfer performance compared to the subjects with blocked practice.

Although J. B. Shea and Morgan (1979) were successful in demonstrating the contextual interference effect in motor learning, their experimental procedure confounded the effect of contextual interference and the effect inherent in a simple vs. choice reaction time (RT) paradigm. Thus, whether levels of contextual interference or the predictability of the next event resulted in the differences between the two practice schedules was not clear. However, Lee and Magill (1983) clearly answered this question with a series of experiments. In their first experiment, cueing of the next event was involved and a factorial design of blocked vs. random conditions and cued vs. uncued conditions was used. The results showed that cued and uncued conditions did not influence the contextual interference effect, indicating that unpredictability of the next event was not the cause of the contextual interference effect. In the second experiment, a serial acquisition
condition where a triplets of task variations were repeatedly performed was added to the blocked vs. random comparison. The serial order enabled subjects to know in advance which task would be performed on the next trial. The results showed that the serial group performed similarly to the random group during acquisition and retention, indicating that the serial order also creates high levels of contextual interference to facilitate learning.

Although effects of practice order on motor skill learning had been studied before J. B. Shea and Morgan (1979) and Lee and Magill (1983), conclusions derived from those early studies were somewhat misleading due to the failure to dissociate performance effects from learning effects. For example, Dunham (1969, 1977, 1978) studied effects of practice order on acquisition of a pursuit rotor task with two arms. A blocked order, where one arm was repeatedly used before practice with the other arm began, was compared with a serial order, where practice with right and left arms were alternated for each trial. The serial order hindered acquisition performance in two (Dunham, 1977, 1978) of the three studies, in consistent with the effect of high contextual interference on acquisition performance. Unfortunately, however, no retention or transfer tests were administered in these studies. Based only on the acquisition performance, Dunham was misled to conclude that less interference during practice leads to better learning, contrary to Battig's notion which dissociated effects of performance and learning. Therefore, the studies by J. B. Shea and Morgan (1979) and Lee and Magill (1983) have significance in that detrimental effects of contextual interference on performance were dissociated from beneficial effects on learning.

Following J. B. Shea and Morgan's (1979) study, many studies have found the contextual interference effect in motor learning. Those studies can be grouped based on the primary purpose of each study. The first group of studies directly focused on investigating why the contextual interference effect occurs. For example, J. B. Shea and Morgan (1979) explained the contextual interference effect from a viewpoint of levels of elaboration imposed on learners. The elaboration view holds that under high levels of
contextual interference during acquisition, information about multiple tasks are simultaneously present in the working memory and more elaboration is required to distinguish one task from the others. This promoted level of elaboration is considered to facilitate learning. This explanation has some empirical support (e.g., Limons & Shea, 1988; J. B. Shea & Zimny, 1988; Wright, 1991; Wright, Li, & Whitacre, 1992).

An alternative explanation has been proposed by Lee and Magill (1985) from a viewpoint of reconstruction of action plans. It states that under high levels of contextual interference, an action plan for a particular task needs to be reconstructed every time that task is performed because the action plan is completely or partially forgotten from the working memory by intervening other tasks. Although this reconstruction process hinders acquisition performance, retention and transfer are enhanced because it is this reconstruction process that is required during retention and transfer tests. The reconstruction view has also been empirically tested and supported by some studies (Lee & Weeks, 1987; Magill, 1988; Meeuwsen & Magill, 1991). Another approach to the mechanism of the contextual interference effect was taken from the viewpoint of disadvantages for low contextual interference practice. Del Rey, Liu, and Simpson (1994) and J. B. Shea and Titzer (1993) showed that under low contextual interference practice, such as blocked practice, tasks that are practiced first suffer from retroactive interference caused by following practice of other tasks. However, this retroactive interference view does not provide an explanation for the transfer effect of contextual interference.

Related to and probably included in this group concerning explanations of the contextual interference effect are the studies that addressed the contextual interference effect in relation to Schmidt's (1975) schema theory. For example, Lee, Magill, and Weeks (1985) argued that a beneficial effect of practicing a variety of tasks on transfer had been found only when tasks were practiced under high levels of contextual interference, suggesting that the effect of variability in practice is attributed to the effect of
contextual interference. Although, Wulf and Schmidt (1988), in contrast to Lee et al.'s view, concluded that facilitation of retention and transfer is due to schema formation but not contextual interference, Hall and Magill (in press) argued that the effect of variable practice and the effect of contextual interference should not be contrasted because they are related to different skill learning situations.

Other groups of studies investigated the generalizability of the effect in a variety of settings. One of these groups included studies that investigated the influence of task characteristics on the contextual interference effect. The contextual interference effect was found with real world motor skills such as volleyball (Bortoli, Robazza, Dungon, & Carra, 1992), rifle shooting (Boyce & Del Rey, 1990), badminton serves (Goode & Magill, 1986; Wrisberg, 1991; Wrisberg & Liu, 1991) and baseball batting (Hall, Domingues, & Cavazos, 1994). These studies provided evidence that the contextual interference effect can occur outside a laboratory. One of other task characteristics investigated concerns cognitive and motor components of skills. Carnahan, Van Eerd, and Allard (1990) proposed that the contextual interference effect occurs only when tasks require generation of overt movements, suggesting that different levels of contextual interference are attributed to the process of learning motor components of a task.

However, the contextual interference effect has been found in imagery practice (Gabriele, Hall, & Lee, 1989) and observational learning (Blandin, Proteau, & Allain, 1994) paradigms where only cognitive components of tasks create different levels of contextual interference. Similarity of task variations is another task characteristic that has recently intrigued many researchers following the Magill and Hall (1990) hypothesis. Similarity has been defined in terms of GMP characteristics in their hypothesis and controversial findings have been reported (Hall & Magill, in press; Lee, Wulf, & Schmidt, 1992; Sekiya, Magill, & Anderson, 1994; Sekiya, Magill, Sidaway, & Anderson, 1994; Wood & Ging, 1991; Wulf, 1992; Wulf & Lee, 1993). Because it is related to the main theme of the present study, it will be discussed in detail in later sections.
The third group includes studies that examined the influence of subject characteristics. One of them is related to skill levels of learners. Although Del Rey (1982) found the contextual interference only for subjects who demonstrated a higher proficiency level of performing a task, other studies failed to find the influence of skill levels on the contextual interference effect (Del Rey, Whitehurst, Wughalter, & Barnwell, 1983; Smith & Rudisill, 1993). Another subject characteristic is related to cognitive styles of learners. Jelsma and his colleagues (Jelsma & Pieters, 1989; Jelsma & Van Merrienboer, 1989) investigated the contextual interference effect for subjects who are considered to be either impulsive or reflective. The impulsive subjects are those who respond to stimuli quickly but with less accuracy, while the reflective subjects are those who react slowly but with more accuracy. The results of these studies showed that the contextual interference effect is more likely to occur for reflective subjects than impulsive subjects. In addition, the contextual interference effect has been demonstrated not only for normal population but also for subjects with Down’s syndrome (Edwards, Elliott, & Lee, 1986) and mental retardation (Heitman & Gilley, 1989).

The last group of studies addressed the influence of experimental procedures on the contextual interference effect. One of procedural characteristics concerns practice conditions. Al-Ameer and Tool (1993) found that a combination of blocked and random schedules during practice was as effective as a pure random schedule to facilitate learning. However, Pigott and Shapiro (1984), using a younger population of subjects, found that the blocked-random mixed schedule was more effective than either a pure blocked or pure random schedule, suggesting that there may be an interaction between practice conditions and subject characteristics. Extra training after practice is another procedural characteristic that may influence the contextual interference effect. Del Rey (1989) found that extra training on tennis skills facilitated benefits of random practice on a coincident timing task.
Although the influence of augmented feedback, which is another procedural characteristic, on the contextual interference effect has been investigated, Del Rey & Shewokis (1993), Dunham, Lemke, and Moran (1991) and Weir (1988) found no influence of feedback manipulations on the contextual interference effect. The only exception is the study by Wulf (1992) in which reducing the frequency of KR presentation facilitated the occurrence of the contextual interference effect. Another and most relevant procedural characteristic to the present review is the amount of practice. Although C. H. Shea, Kohl and Indermill (1990) found that the amount of practice is a factor that influences the efficacy of the contextual interference effect, Proteau, Blandin, Alain and Dorion (1994) found no influence of the amount of practice. However, because task variations used in these studies can be contrasted from a viewpoint of underlying GMP structures, these inconsistent findings will be discussed with regard to the interactive influence of the amount of practice and GMP characteristics in later sections.

Taken together, although the contextual interference effect has been found with a variety of tasks, subjects and experimental procedures, there were some occasions in which the contextual interference effect was not found. Investigation of the generalizability of the contextual interference effect has been approached separately from either task, subject or procedural characteristics, as the studies could be grouped based on which factor researchers were interested in. However, the influence of multiple factors and interactions among them have rarely been investigated.

The Magill and Hall (1990) Hypothesis

One of the single factor approaches was taken from the viewpoint of task characteristics and it is well represented as the hypothesis proposed by Magill and Hall (1990). They proposed a limitation to the generalizability of the contextual interference effect with respect to underlying GMP structures of task variations to be learned. Although the hypothesis has been examined by many studies, findings were inconsistent
among those studies (e.g., Lee, Wulf, & Schmidt, 1992; Sekiya, Magill, Sidaway, & Anderson, 1994). Therefore, in this section, the Magill and Hall hypothesis and a rationale for it will be presented followed by the findings of studies that examined the hypothesis.

The Magill and Hall (1990) hypothesis consists of two parts. First, when task variations to be learned are governed by different GMPs, the contextual interference effect would be found. Second, when task variations are governed by the same GMP, the contextual interference effect should not be found or a combination of blocked and random practice schedules would lead to better learning than a pure blocked or a pure random practice schedule. The GMP is a hypothetical notion for a memory representation that governs a class of movements (Schmidt, 1975, 1985, 1988). The GMP has invariant features such as relative timing and relative force and variant features such as overall duration and overall force. The invariant features refer to compositional relationships of time and force among movement components and are the fundamental structures of the GMP. The variant features are parameters added to the fundamental GMP structures and scaling of movements can be performed by modifying parameters of the GMP. Under this conceptualization, task variations with different invariant and variant features belong to different movement classes and are controlled by different GMPs. On the other hand, when task variations share the same invariant features but differ only in variant features, the task variations belong to the same movement class and are controlled by the same GMP. For example, three different tennis strokes, such as a serve, a forehand ground stroke and a backhand ground stroke, are controlled by three different GMPs, while hitting a serve with different amounts of force requires parameter modifications of the same GMP. According to the hypothesis, the contextual interference effect is unlikely to occur when task variations from the same GMP are learned.
A Rationale for the Hypothesis

The Magill and Hall (1990) hypothesis was based on the reconstruction hypothesis proposed by Lee and Magill (1983, 1985) to explain the mechanism of the contextual interference effect. Lee and Magill suggested that when several tasks are practiced under a high contextual interference condition, action plans for each task need to be reconstructed every time they are performed because forgetting occurs due to the intervention of other tasks. In contrast, when one task is practiced consecutively under a low contextual interference condition without the intervention of other tasks, an action plan for the task can be used without reconstruction. Thus, the reconstruction process under the high contextual interference conditions hinders acquisition performance. However, this more effortful information processing mode leads to enhance memory representations that are measured as retention and transfer performance.

Because the action plan consists of a fundamental GMP structure and parameters added to it, action plan reconstruction consists of GMP construction and parameter modifications (Magill & Hall, 1990). When task variations controlled by different GMPs are practiced under high contextual interference conditions, both GMP construction and parameter modifications are necessary from one performance to another. This complete reconstruction of the action plan under high contextual interference practice requires more effortful processing than under low contextual interference. Therefore, the contextual interference effect is found with task variations controlled by different GMPs. In contrast, when task variations controlled by the same GMP are practiced under high contextual interference conditions, only parameter modifications are necessary from trial to trial, leading to minor interference that is similar to one created under low contextual interference conditions. Because this minor interference does not lead to effortful processing, no contextual interference effect is expected to occur when task variations share the same GMP structure.
In addition, the Magill and Hall (1990) hypothesis states that a mixed practice schedule of blocked order followed by random order facilitates learning when task variations require only parameter modifications of the same GMP. This prediction was based on the results of the study by Pigott and Shapiro (1984). In this study, subjects experienced throwing beanbags of different weights toward a target under blocked practice, random practice or a combination of blocked and random practice where 3-trial blocks were randomized. The results showed that only the mixed practice schedule facilitated transfer to a novel weight. Although the results of this study supports the Magill and Hall's prediction, no rationale for this prediction in terms of GMP characteristics was explicitly stated in the review by Magill and Hall.

Tests of the Hypothesis

The Magill and Hall (1990) hypothesis is indirectly supported by studies that found no contextual interference effect with task variations controlled by the same GMP. When variations of a pursuit rotor task with different movement speeds were learned, no contextual interference effect was found (Heitman & Gilley, 1989; Whitehurst & Del Rey, 1983). Variations of a linear positioning task with different movement distances also revealed no contextual interference effect (Turnbull & Dickinson, 1986). In addition, Wulf (1992) had subjects practice moving a lever by hand to reproduce goal spatio-temporal movement patterns that required modifications of the overall force parameter of the same GMP. The results of this study supported the Magill and Hall hypothesis as the contextual interference effect was not found for task variations controlled by the same GMP unless frequency of knowledge of results (KR) presentation was reduced to promote the level of processing.

Wulf and Lee (1993) also examined the Magill and Hall (1990) hypothesis using a data analysis technique that enabled them to dissociate performance measures related to parameter learning from performance measures related to GMP learning. They had subjects practice hitting four buttons so that movement times (MTs) for each segment
match goal MTs for each segment. The task variations learned had goal MTs in the same relative timing composition, but the variations differed only in total MTs. Thus, these task variations required modifications of the overall duration parameter of the same GMP. With the dissociation measurement technique, parameter learning was assessed based on differences between the goal total MTs and observed total MTs, while GMP learning was assessed based on differences between the goal relative timing and observed relative timing. The significance of using this dissociation measurement technique is that the rationale for the Magill and Hall hypothesis that parameter modifications do not create sufficient interference to produce the contextual interference effect can be directly examined. In the previous study that used the similar task variations (Lee et al., 1992), only a general performance measure that reflects both GMP learning and parameter learning together was used, making the direct examination of the rationale for the hypothesis impossible. The results of Wulf and Lee’s study showed that, in support of the Magill and Hall hypothesis, no contextual interference effect was found for the measure of parameter learning in both retention and transfer.

Although these findings described above are consistent with the prediction of the Magill and Hall (1990) hypothesis, none of these studies compared task variations from different GMPs with task variations from the same GMP. To attribute the lack of the contextual interference effect solely to the task characteristics, it is necessary to involve both types of task variations within an experiment. This approach was used by Wood and Ging (1991). They used task variations with high and low similarity within a study to investigate the influence of the task characteristics. One set of task variations required subjects to knock down small barriers with one hand in different spatial configurations. The other set of task variations had barriers in a similar “N” shape pattern but with different sizes. However, the nature of these task variations and the data analysis techniques had two inherent problems to support the Magill and Hall hypothesis.
First, as the authors also pointed out in their discussion, the high similarity task variations did not share the same relative timing structure. Thus, the task variations can not be considered to be controlled by the same GMP. Second, their conclusion that the contextual interference effect was found only for low similarity task variations was derived based on the analysis of performance transition from acquisition to retention. This analysis confounded performance effects and learning effects. When the absolute performances in retention and transfer were analyzed, no contextual interference effect was found for either the high or low similarity task variations. Therefore, although this study has been cited as a source of a support for the Magill and Hall hypothesis (Chamberlin & Lee, 1993; Magill, 1992, 1993; Magill & Hall, 1990), it does not provide strong support for the Magill and Hall hypothesis.

Another within-study approach was used by Lee, Wulf and Schmidt (1992). They had subjects practice variations of a sequential tapping task that had either the same or different relative timing structures. Although the retention results showed no contextual interference effect regardless of the task characteristics, the transfer results showed the contextual interference effect only for the different GMP task variations but not for the same GMP task variations. Thus, this study provided a partial support for the Magill and Hall hypothesis.

Although the results of the studies described above are consistent with the prediction derived from the Magill and Hall (1990) hypothesis, some recent studies found the contextual interference effect with task variations that are considered to be controlled by the same GMP. The contextual interference effect was found when Carnahan, Van Eerd, and Allard (1990) had subjects practice variations of a timing task that required modifications of the overall duration parameter of the same GMP. In another study by C. H. Shea, Kohl, and Indermill (1990), subjects learned variations of a rapid force production task that required modifications of the overall force parameter of the same GMP. The results showed the contextual interference effect when the amount of practice
was increased. Young, Cohen, & Husak (1993), using variations of a rapid aiming task with similar movement patterns, found the contextual interference effect. In addition, Hall et al. (1994) had skilled baseball players practice hitting fastballs, curveballs and change-ups. Although the movements to hit these types of pitches are very similar and they are considered to be governed by the same GMP, the results of this study showed a contextual interference effect. These findings are inconsistent with the Magill and Hall hypothesis that predicts no contextual interference effect with this type of task variation.

Sekiya, Magill, Sidaway and Anderson (1994) more directly examined the hypothesis by combining the experimental procedures used by Lee et al. (1992) and Wulf and Lee (1993). In this study, task variations controlled by either the same or different GMPs, which were similar to that used by Lee et al., were practiced in either a high or low contextual interference condition. In data analysis, in addition to a general performance measure, GMP learning and parameter learning were assessed separately using a dissociation measurement approach similar to that used by Wulf and Lee. The results of the general performance measure revealed the contextual interference effect regardless of the task characteristics, contrary to the Magill and Hall (1990) hypothesis. When the dissociated measures of GMP learning and parameter learning were examined, further evidence was found against the Magill and Hall's rationale for the hypothesis that parameter modifications do not create sufficient interference to produce the contextual interference effect. With the task variations from the same GMP, the measure of parameter learning revealed a clear contextual interference effect, suggesting that parameter modifications can create sufficient interference to facilitate learning contrary to the rationale of the hypothesis.

Furthermore, these findings by Sekiya, Magill, Sidaway and Anderson (1994) with modifications of the overall duration parameter were replicated in the study by Sekiya, Magill and Anderson (1994) with modifications of the overall force parameter. In this study, subjects practiced moving a computer mouse along a linear track to
reproduce goal spatio-temporal movement patterns that required modifications of the overall force parameter of the same GMP. The results showed that the contextual interference effect was found for a general performance measure as well as for a measure of parameter learning. This study provided further evidence that parameter modifications of the same GMP lead to effortful information processing under high contextual interference practice to subsequently facilitate learning.

Additionally, another evidence against the Magill and Hall hypothesis (1990) can be seen in the results of the study by Hall and Magill (in press). They used task variations from both the same and different GMPs within a study as it was the case in the studies by Lee, Wulf and Schmidt (1992) and Sekiya, Magill, Sidaway and Anderson (1994). In this study, many different types of retention and transfer tests were used. The results showed that the contextual interference effect was found in some of the tests regardless of the GMP characteristics of the task variations. Therefore, both types of task variations produced the contextual interference effect, contrary to authors' claim in discussion that the contextual interference effect was found only for the task variations from different GMPs. To conclude that the contextual interference effect was found for task variations from different GMP but not for task variations from the same GMP, an interaction between the GMP characteristics and practice schedules needs to be found in the analysis of test performance. However, this interaction was not evident for all contextual interference effects found in this study. Therefore, the results of this study contradict the Magill and Hall hypothesis.

Although there are many studies that support or do not support the Magill and Hall (1990) hypothesis, the fact that the contextual interference effect was found in many studies that used task variations controlled by the same GMP suggests that this type of task variation can produce the contextual interference effect under some conditions. It is therefore questionable that the same vs. different GMP contrast is such a powerful single factor that determines the occurrence of the contextual interference effect. Rather, it is
possible that the GMP characteristics interacts with other characteristics such as subjects and experimental procedures. Therefore, it is necessary to investigate the generalizability of the contextual interference effect by considering interactions of several factors to clarify the inconsistent findings concerning the Magill and Hall hypothesis. One possible interaction briefly mentioned in an early section is the interaction between the GMP characteristics and the amount of practice. How this interaction can clarify the inconsistent findings related to the influence of GMP characteristics and the amount of practice will be discussed in the following section. Because many studies have been published since Magill and Hall (1990), it is now possible to reexamine the generalizability of the contextual interference effect from the view of the interactive influence of these factors which requires more recent findings and more between-study comparisons than that were available at the time of Magill and Hall's review.

Generalized Motor Program Characteristics and Amount of Practice

In contrast to the single factor approach taken by Chamberlin and Lee (1993) and Magill and Hall (1990), an alternative is to view the generalizability of the contextual interference effect as the interactive influence of two factors. This interaction involves the GMP characteristics as one factor and the amount of practice as the other factor. The Magill and Hall (1990) hypothesis concerning only the GMP characteristics should be extended by considering the influence of the amount of practice on the contextual interference effect. Because the amount of practice is directly related to stages of learning (Magill, 1993), understanding characteristics of stages of learning in terms of different task demands required on each stage would help understand why the amount of practice and GMP characteristics interactively influence the contextual interference effect. Because several models have been proposed to identify different characteristics of stages of motor learning, those models will be briefly described before the interactive influence of the amount of practice and the GMP characteristics is discussed.
In addition, some theoretical frameworks have been proposed by motor learning theorists (Kugler, Kelso, & Turvey, 1980; Newell, 1985; Schmidt, 1988) to identify the hierarchical structure of the movement organization. Because these frameworks are related to concepts of GMP and parameters and these frameworks refer to what aspect of a motor skill is learned before other aspects are learned, an attempt will be made in the following section to synthesize the different models of stages of learning by establishing connections between the GMP characteristics and stages of learning. Then, a modification to the Magill and Hall (1990) hypothesis will be proposed considering the interaction between the GMP characteristics and the amount of practice.

**Stages of Motor Learning**

There are three models proposed to identify stages of learning. Fitts (1964; Fitts & Posner, 1967) identified three stages of motor learning. In the first stage, called the cognitive phase, a learner tries to understand the goal of the task and what needs to be done to achieve the goal. This stage is also characterized by a large variability in movements because different movements result from a variety of strategies used by the learner. In the second stage, called the associative phase, the learner develops appropriate movement patterns to perform the task. As the movement patterns become stable, fine adjustments are made to reduce the variability in movements. In the last stage, called the autonomous phase, the learner reduces attention demand imposed by the task and becomes capable of doing other tasks simultaneously. Although these stages have distinct characteristics, the learner does not move abruptly from one stage to the next. Rather, changes occur gradually along a continuum of the amount of practice (Magill, 1993). Additionally, although the first two stages have been studied by motor behavior researchers, the last stage of learning have not been studied extensively because the learner needs thousands or millions of practice trials to reach the autonomous phase (Schmidt, 1988). It is worth noting that most of the studies concerning the contextual
interference effect used a limited number of practice trials that corresponds to the first two stages of learning proposed by Fitts and Posner.

Although Adams (1971) identified only two stages of motor learning, the first stage, which was labeled the verbal-motor stage, has the similar characteristics as the first two stages proposed by Fitts (1964; Fitts & Posner, 1967). The second stage was termed the motor stage and the learner in this stage can perform consistently because an error detection mechanism has already been developed. Because conscious awareness of what needs to be performed is minimum in this stage, it is similar to the autonomous phase proposed by Fitts. Although only two stages were identified by Adams, his model essentially involves all characteristics proposed by Fitts.

The third model proposed by Gentile (1972) also identified only two stages of learning. The first stage is characterized as the period of getting the idea of the movement. In this stage, two aspects are emphasized. First, the learner dissociate relevant stimuli from non-relevant stimuli in the environment. Second, the learner develops coordinated movement patterns that are appropriate for achieving the goal of the task. In contrast to the first two models proposed by Fitts (1964; Fitts & Posner, 1967) and Adams (1971), the second stage proposed by Gentile has two distinct characteristics depending on the nature of the task. When a closed motor skill, where the environment does not change during a trial or from trial to trial, is to be learned, the main goal is to refine the movement that was already developed in the first stage. This process was called fixation. On the other hand, when the task to be learned is an open motor skill, where the environment changes during a trial or from trial to trial, diversification is the primary goal. The diversification refers to process of increasing movement repertoire in order to adapt to the changing environment.

Although the three models described above have different numbers of stages and different labels for the stages, some commonalities exist among them. First, all of the models emphasize the importance of cognitive demand in early practice and it decreases as
practice progresses. Second, all of the models maintain that in early practice the learner searches the most appropriate movement pattern from a variety of possible movement patterns. This is then followed by refining and stabilizing the selected movement pattern in later practice. This transition from acquisition of fundamental movement patterns to refinement of them is consistent with the hierarchical organization of the movement proposed by some motor learning theorists. According to Kugler et al. (1980) and Newell (1985), the most appropriate movement pattern is selected through the process of acquisition of coordination, which is defined as topological relationships in the body and limbs. Refinement of the movement is achieved by control of the movement, which is defined as scaling of movement parameters. Because control of the movement is achieved on the basis of acquisition of coordination, the coordinated movement pattern is established in the early stage of learning and the further practice leads to control of the movement. This hierarchical organization of coordination and control is consistent with the features that all of the models of learning stages have in common.

Although another hierarchical organization of the movement was proposed by Schmidt (1988), it is essentially the same as the hierarchy proposed by Kugler et al. (1980) and Newell (1985). According to Schmidt, coordinated movement patterns are characterized as invariant features of the GMP, such as relative timing and relative amount of force. Thus, acquisition of coordination is synonymous with development of the appropriate GMP structure. On the other hand, refinement of the movement is the process of adding the appropriate parameters, such as overall movement duration and overall amount of force, to the already developed coordinated movement pattern. Therefore, modifications of parameters are achieved on the basis of developing the fundamental GMP structure. Although terms used by Schmidt are different from those used by Kugler et al. and Newell, they essentially refer to the same hierarchical structure that is incorporated in the models of learning stages.
Therefore, for the purpose of examining the interactive influence of GMP characteristics and the amount of practice on the contextual interference effect, two stages of learning are identified in the present study. In the first stage, the learner develops fundamental movement patterns that have been labeled coordination or GMP. Also, this stage is characterized by emphasized cognitive demands to search for the most appropriate movement patterns. In the second stage, the learner refines the selected movement patterns by adding parameters. Less cognitive demands are imposed on the learner in this stage of learning and movements are produced relatively automatically compared to the first stage. Although distinct characteristics for these stages are identified, transition from one stage to the other occurs gradually along a continuum of the amount of practice.

When the contextual interference effect is associated with these stages of learning, the locus of contextual interference in each stage of learning can be predicted. Because the learner develops the fundamental GMP structure in early practice, this process of searching the most appropriate movement pattern would be the locus of the contextual interference effect in this stage of learning. In contrast, parameter modifications become the primary task demand imposed on the learner in later practice, suggesting that the locus of the contextual interference would be the process of parameter modifications in the later stage of learning. In other words, GMP learning is the source of different levels of contextual interference in early practice, while parameter learning is the source of different levels of contextual interference in later practice.

Interactive Influence of Generalized Motor Program Characteristics and Amount of Practice

In the preceding section, a prediction was made in terms of a shift of the locus of contextual interference as a function of the amount of practice. The transition of the locus of contextual interference from GMP learning in early practice to parameter learning in later practice suggests that the GMP characteristics of task variations should interact with the amount of practice. The Magill and Hall (1990) hypothesis concerned only one of
these factors, that is, the GMP characteristics. In this section, this possible interaction will be discussed based on empirical findings to provide a more appropriate framework for the generalizability of the contextual interference effect.

A good example of the influence of the amount of practice on the contextual interference effect for learning task variations from the same GMP can be seen in the study by C. H. Shea et al. (1990) in which three different amounts of practice were used. They had subjects practice variations of a ballistic force production task with different amounts of force. Thus, these task variations required modifications of the overall force parameter of the same GMP. The task variations were practiced in either a blocked or random context for either 50, 200, or 400 trials. One day after acquisition, retention performance was measured in either a blocked or random context. The results of the retention test showed that after 50 acquisition trials no contextual interference effect was found. In contrast, after 400 acquisition trials a clear contextual interference effect was found in both retention test contexts. After 200 trials, a somewhat moderate effect was found as the random group performed better than the blocked group only in the random retention context. This study demonstrated that the efficacy of the contextual interference effect improved as the amount of practice increased.

When this finding is related to the hierarchical structure of the movement organization, the interaction between the GMP characteristics and the amount of practice becomes clearer. Along the continuum of the amount of practice, the fundamental structures of the movement, such as relative timing and relative force, are developed before specific details of movements, such as overall duration and overall force, are refined. In other words, for the learner in early practice GMP learning is more demanding than parameter learning, while in later practice parameter learning is more demanding than GMP learning. When task variations from the same GMP are to be learned, the learner in early practice focuses on the fundamental GMP structure regardless of practice contexts. Although the task variations differ in the parameters added to the
OMP, the learner in early practice tends to ignore the specific details of the movement. Therefore, in early practice a potential source of different levels of contextual interference is not actively processed by the learner. Because the learner focuses on the fundamental GMP structure that is identical among task variations from the same GMP, little difference is created in information processing under high and low contextual interference practice.

However, with further practice learner's attention shifts from the fundamental GMP structure to more specific details of the movement. Thus, in later practice the learner focuses on modifications of the parameters. Because modifications of the parameters are demanded in later practice, practice schedules with different levels of contextual interference invoke different information processing modes in this stage of learning. Under low contextual interference schedules, such as the blocked practice, parameters of the same GMP do not have to be modified but simply repeated from trial to trial. In contrast, under high contextual interference schedules, such as the random or serial practice, parameters need to be modified from trial to trial due to the changing task demands. Therefore, the difference in the information processing modes under the high and low contextual interference schedules becomes evident only after a sufficient amount of practice is administered. Although these predictions are consistent with the findings by C. H. Shea et al. (1990) in which the influence of the amount practice was manipulated within an experiment, more evidence to support these predictions based on between-study comparisons will be discussed next.

When the inconsistent findings with task variations controlled by the same GMP are reviewed in the light of the amount of practice, it is likely that the contextual interference effect would not be found in studies with a relatively small number of acquisition trials, while the effect would be found in studies with a relatively large number of acquisition trials. The number of trials greater than 200 have consistently produced the contextual interference effect, while many studies with the number of trials
less than 150 have failed to find the contextual interference effect. Studies with the number of trials between 150 and 200 have reported inconsistent findings. Although these numbers are presented as a reference for reviewing the studies, exact number of trials to distinguish relatively small and large amount of practice is not important, because the comparisons are made between studies that have a variety of task, subject and procedural characteristics. Rather, a more important aspect that should be derived from the between-study comparisons is a general tendency toward the increased possibility of finding the contextual interference effect as a function of the amount of practice. Additionally, because these numbers were derived from the studies that used tasks requiring relatively simple movements in laboratory settings, application of the numbers should be restricted to these situations.

For example, variations of a pursuit rotor task with only 15 (Heitman & Gilley; 1989) or 50 acquisition trials (Whitehurst & Del Rey, 1983) and variations of a linear positioning task with only 15 acquisition trials (Turnbull & Dickinson, 1986) have revealed no contextual interference effect. Also, when subjects practiced producing goal spatio-temporal movement patterns that differed only in the amount of overall force with 90 acquisition trials, no contextual interference effect was found unless the frequency of KR presentation was manipulated (Wulf, 1992). In another study by Wulf and Lee (1993), subjects practiced variations of a timing tapping task for 108 trials, but no contextual interference effect was found except for a delayed transfer test with one of the dependent measures used. Although this study provided a partial support for the Magill and Hall (1990) hypothesis, similar task variations practiced for 90 and 180 acquisition trials revealed no contextual interference effect (Lee et al., 1992).

In contrast, the contextual interference effect has been found when task variation governed by the same GMP were practiced with a relatively large number of acquisition trials. In the studies by Hall and Magill (in press) and Sekiya, Magill, Sidaway and Anderson (1994), subjects practiced variations of a timing tapping task that were very
similar to those used by Lee et al. (1992) and Wulf and Lee (1993). However, the number of acquisition trials was increased to 198 in the study by Hall and Magill and 270 in the study by Sekiya, Magill, Sidaway and Anderson. The contextual interference effect was found with the same GMP task variations in both studies, contrary to the Magill and Hall (1990) hypothesis. In another study by Sekiya, Magill and Anderson (1994), subjects practiced task variations requiring modifications of the overall force parameter for a total of 540 acquisition trials. The results showed a reliable contextual interference effect as it was evident after both 270 and 540 acquisition trials. In addition, Young et al. (1993) had subjects practice variations of a rapid aiming task for 192 acquisition trials and found the contextual interference effect. Therefore, when task variations share the same GMP structure, there exist a tendency toward that the possibility of finding the contextual interference effect increases as the amount of practice increases. The only exception is the study by Carnahan et al. (1990). In this study, subjects learned knocking down a barrier by one hand in three MTs. Although variations of this timing task required modifications of the overall duration parameter of the same GMP, the contextual interference effect was found after only 60 acquisition trials. One possibility for finding the contextual interference effect with this small number of trials is that the movement required to perform this task was so simple that development of a coordinated movement pattern was achieved with only a few trials. It is therefore suggested that because subjects were involved in the process of parameter modifications from the beginning of practice, different levels of contextual interference were created with this relatively small amount of practice.

Although the studies described above used tasks that were new to subjects, an well learned skill that require only parameter modifications of the GMP in a later stage of learning has also been studied. Hall et al. (1994) had skilled baseball players practice hitting different types of pitches. Because the subjects had years of experience of this skill, they are considered to be in the later stage of learning in which parameter
modifications are the primary task demand. Because the contextual interference effect was found in this study, it provides further evidence to support that the parameter modifications of the same GMP creates the contextual interference effect even after an extensive amount of practice.

In contrast to the findings with task variations controlled by the same GMP, there is no evidence that the amount of practice interacts with the efficacy of the contextual interference effect when task variations are controlled by different GMPs. Proteau, Blandin, Alain and Dorion (1994) investigated the influence of the amount of practice using three different amounts of practice within a study. Because subjects learned knocking down barriers in different spatial patterns, variations of this task were governed by different GMPs. The results revealed that the contextual interference effect was equally found after 54, 108 and 216 acquisition trials, indicating no influence of the amount of practice.

The between-study comparison also suggests no evidence that the amount of practice influences the contextual interference effect when task variations from different GMPs are learned. Although most of the studies with this type of task variations used a relatively small number of acquisition trials, the contextual interference effect was found in many studies. For example, variations of a barrier knockdown task produced the contextual interference effect after 54 trials (Al-Ameer & Toole, 1993; Del Rey, Liu & Simpson, 1994; Lee & Magill, 1983; Limons & Shea, 1988; J. B. Shea & Morgan, 1979; J. B. Shea & Titzer, 1993; Wright, Li & Whitacre, 1992) and 60 trials (Lee, Magill & Weeks, 1985). With a similar task that required hitting buttons instead of barriers in different spatial patterns, the contextual interference effect was found after 135 acquisition trials (Meeuwsen & Magill, 1991; Experiment 3). In the studies where variations of a tapping task had different relative timing structures, the contextual interference effect was found after 198 trials (Hall & Magill, in press) and 270 trials (Sekiya, Magill, Sidaway, & Anderson, 1994). When Goode and Magill (1986) had subjects practice three types of
badminton serves for the relatively large number of 324 trials, the contextual interference effect was found. The contextual interference effect with two types of badminton serves was also found when the number of acquisition trials was 90 (Wrisberg & Liu, 1991) and 216 (Wrisberg, 1991).

This between-study comparison and Proteau et al.'s (1994) within-study comparison provide no evidence for the influence of the amount of practice on the contextual interference effect when task variations are governed by different GMPs. It is worth noting that, in contrast to task variations governed by the same GMP, task variations governed by different GMPs consistently produced the contextual interference effect with a relatively small number of acquisition trials. This is also explained in terms of the hierarchical structure of motor learning. In early practice, a learner tries to develop the fundamental GMP structure, such as relative timing and relative force. When task variations that have different relative timing or different relative force are learned, the learner needs to develop distinct GMP structures in the early stage of learning. Under high contextual interference practice, such as random and serial practice, this type of task variations impose different task demands on the learner from one performance to another. In contrast, under low contextual interference schedules, such as blocked practice, the same task demand is repeatedly required except when the task is changed from one block to another. Therefore, this type of task variations invokes different information processing modes under different levels of contextual interference in early practice. The more elaborated information processing of the GMP structure under high contextual interference practice is detrimental for acquisition but beneficial for retention and transfer. This suggests that the contextual interference effect occurs even in early practice when task variations are from different GMPs.

On the other hand, if practice of this type of task variations progresses further, the learner's attention shifts from the fundamental GMP structures to scaling of parameters. Under high contextual interference practice, parameters added to the GMPs need to be
modified from trial to trial because reconstruction of the GMP structures leads to modifications of parameters that are specific to each GMP. In contrast, under low contextual interference practice, reconstruction of the GMP is not necessary from trial to trial because task demands do not vary except for when tasks are changed between blocks. If the GMP is not changed from one trial to another, parameters that are specific to the GMP are not modified, too. Therefore, practicing this type of task variations under the high and low contextual interference schedules in later practice imposes differential processing modes in parameter modifications. This suggests that the contextual interference effect should be found with task variations controlled by different GMPs even when a relatively large amount of practice is administered.

In summary, a modification to the Magill and Hall (1990) hypothesis is proposed. The modified hypothesis involves the interaction between the GMP characteristics and the amount of practice. When task variations are controlled by the same GMP, the contextual interference effect is expected to occur only after a relatively large amount of practice. This type of task variations has only parameter modifications as a source of different processing modes created by different levels of contextual interference. However, because this potential source of different processing modes is not processed by the learner in early practice, no contextual interference is expected to occur at this stage of learning.

In contrast, when task variations controlled by different GMPs are learned, the contextual interference effect can be found in both early and later practice. With this type of task variations, both GMP construction and parameter modifications are sources of different processing modes. The high and low contextual interference practice schedules lead to different processing modes in GMP learning in early practice and in parameter learning in later practice.

Implications for Understanding the Contextual Interference Effect

Although an attempt was made in the previous section to propose a new framework that helps understand the generalizability of the contextual interference effect,
theoretical considerations for why the contextual interference effect occurs have not been discussed extensively to this point. Because there are some hypotheses proposed to explain the mechanism of the contextual interference effect, how those hypotheses can explain the interaction between the GMP characteristics and the amount of practice will be discussed in this section.

Two hypotheses have been cited often in the contextual interference literature. One is the elaboration hypothesis proposed by J. B. Shea and his colleagues (Shea & Morgan, 1979; Shea & Zimny, 1983) and the other is the action plan reconstruction hypothesis proposed by Lee and Magill (1985). These two hypotheses explain the mechanism of how different practice schedules create different levels of contextual interference and how they influence acquisition, retention and transfer of motor skills. However, these hypotheses mislead the prediction about the generalizability of the contextual interference effect when different amounts of practice are concerned. Because the hypotheses did not refer to whether GMP learning or parameter learning is the source of contextual interference, they do not provide an appropriate explanation for the interactive influence of the GMP characteristics and the amount of practice on the contextual interference effect. The necessity of incorporating the concept of sources of contextual interference in the hypotheses will be discussed.

The elaboration hypothesis maintains that under low contextual interference practice schedules, information about only one task is present in the working memory at a time. In contrast, under high contextual interference practice schedules, information about multiple tasks are simultaneously present in the working memory. The latter situation engages the learner in more distinctive processing because one task needs to be distinguished from the other. This distinctive processing requires elaboration because the tasks are encoded with a variety of strategies to make the retrieval from the memory successful. On the other hand, when only one task resides in the working memory at a time under blocked practice, no distinctive processing is required because the task does
not need to be compared with other tasks. This situation engages the learner in a relatively simple and automatic processing mode, requiring less elaboration. Therefore, the distinctive and elaborate processing mode during high contextual interference practice leads to hindered acquisition performance compared to low contextual interference practice. However, elaboration during practice enhances strength of memory representations, which is measured as facilitated retention, and independence on practice context, which is measured as facilitated transfer.

Although the elaboration hypothesis explains how different levels of contextual interference are created by practice schedules, it does not explicitly state what component of the task, as it relates to the GMP structure and parameters, is the source of different levels of contextual interference. Because the interaction between the GMP characteristics and the amount of practice is related to both levels and sources of contextual interference, the elaboration hypothesis which concerns only levels of interference does not provide an appropriate prediction about the influence of this interaction on the contextual interference effect. The elaboration hypothesis predicts that the contextual interference effect is more likely to occur when task variations are controlled by the same GMP, because more distinctive and elaborate processing is required due to the similarity among the task variations. This prediction is inconsistent with the hypothesis proposed in the present study that the contextual interference effect would be found at any stage of learning with task variations from different GMPs.

However, if the concept of sources of contextual interference is incorporated in the elaboration hypothesis, the interaction between the GMP characteristics and the amount of practice proposed in the present study can be explained from the elaboration view. With task variations from the same GMP, the process of parameter modifications is the only potential locus of elaboration because this type of task variations has indistinguishable GMP features. In early practice, however, the learner does not focus on parameter modifications because developing the most appropriate GMP is the primary
task demand imposed on the learner in this stage. This results in no distinctive and elaborate processing under both high and low contextual interference schedules, leading to no contextual interference effect. On the other hand, in later practice, the process of parameter modifications becomes the locus of elaboration because parameters need to be distinguished in this stage. Thus, with this type of task variations, the contextual interference effect is predicted to occur only in the later stage of learning.

In contrast, when task variations are controlled by different GMPs, both GMP learning and parameter learning are potential sources of different levels of contextual interference. With this type of task variations, GMP learning is the locus of elaboration in early practice while parameter learning is the locus of elaboration in later practice, suggesting that different levels of contextual interference can be created in both early and later stages of learning. Therefore, the elaboration hypothesis can make an appropriate prediction about this interactive influence of the GMP characteristics and the amount of practice on the contextual interference effect only when the sources of contextual interference are incorporated in the hypothesis.

The reconstruction hypothesis also primarily concerns levels of contextual interference. It holds that, under high contextual interference practice schedules, an action plan is fully or partially forgotten from the working memory when intervening tasks are performed. Thus, the action plan needs to be fully or partially reconstructed every time the task is performed. This reconstruction process leads to effortful processing. In contrast, low contextual interference practice schedules do not require the reconstruction process because the action plan for the task is always available in the working memory, leading to less effortful processing. Because the high contextual interference during acquisition leads to more effortful processing, it is detrimental to acquisition performance but beneficial to learning. Therefore, the reconstruction hypothesis concerns only levels of effort produced by different levels of contextual interference. Although the concept of action plan was used to state the hypothesis, the
GMP and parameters that are components of the action plan were not considered as separate sources of contextual interference. Thus, the Magill and Hall (1990) hypothesis that was based on the reconstruction hypothesis was misled to the incomplete prediction that task variations from the same GMP do not produce contextual interference regardless of stages of learning.

However, as it was the case for the elaboration view, if sources of contextual interference are incorporated in the reconstruction hypothesis, the interaction between the GMP characteristics and the amount of practice can be explained. When task variations are from the same GMP, the parameter modification process is the only source of contextual interference because the locus of reconstruction is limited to parameters. Because this part of the action plan is reconstructed only in later practice, different levels of contextual interference is created only in this stage of learning. In contrast, when task variations from different GMPs are learned under a high contextual interference schedule, the fundamental GMP structure which is a part of the action plan is reconstructed in early practice while the parameter which is another part of the action plan is reconstructed in later practice. Therefore, the locus of different levels of contextual interference shifts from GMP learning to parameter learning as a function of the amount of practice. Because different levels of contextual interference are created throughout practice, this type of task variations produces the contextual interference effect in both stages of learning.

Taken together, both the elaboration and the reconstruction hypotheses make inappropriate predictions about the interactive influence of the GMP characteristics and the amount of practice on the contextual interference effect. This happens because both hypotheses account only for levels of contextual interference. To derive an appropriate prediction, it is necessary to extend the hypotheses by incorporating the concept of sources of contextual interference. It is therefore suggested that both levels and sources
of contextual interference need to be considered when predictions about the
generalizability of the contextual interference are made.

Conclusion and Suggestions for Future Research

In the present study, the contextual interference research related to the Magill and Hall (1990) hypothesis about task characteristics was reviewed to reexamine the hypothesis. Through this process, describing the weaknesses of the hypothesis led to proposing a multiple factor approach to the generalizability of the contextual interference effect. A modification to the Magill and Hall hypothesis was proposed considering the interaction between task characteristics and the amount of practice. The modified hypothesis holds that when task variations are controlled by different GMPs, the contextual interference effect would be found in both early and later practice. In contrast, when task variations are controlled by the same GMP, the contextual interference effect would be found only in later practice.

However, because this modified hypothesis was derived based on comparisons of the studies with a variety of task, subject and procedural characteristics, a more direct examination of the hypothesis needs to be done by manipulating task characteristics and the amount of practice within a study. A possible test of this hypothesis would include four groups of subjects that are combinations of two types of task characteristics and two levels of contextual interference. The first two groups would practice task variations from different GMPs, with one group having a low level of contextual interference and the other group having a high level of contextual interference. The remaining two groups would be exposed to task variations from the same GMP, with one of them having a low level of contextual interference and the other having a high level of contextual interference. Then groups with high and low contextual interference practice schedules for each type of task characteristic can be compared after different amounts of practice. If the present hypothesis is valid, then increasing the amount of practice should increase the likelihood of finding the contextual interference effect for the groups that learn task
variations from the same GMP. For the other groups with task variations from different GMPs, however, the contextual interference effect should be found regardless of the amount of practice.

The modified hypothesis proposed here suggests that because different aspects of learning are demanded at different stages of learning, the generalizability of the contextual interference effect should consider the influence of the amount of practice. It is therefore suggested that other factors, such as subject characteristics, may interact with the amount of practice when the efficacy of the contextual interference effect is examined. For example, Jelsma and his colleagues (Jelsma & Pieters, 1989; Jelsma & Van Merrienboer, 1989) investigated the generalizability of the contextual interference effect in terms of subject's cognitive styles. They proposed that the contextual interference effect is likely to occur for reflective subjects but not for impulsive subjects. However, because the number of practice trials used in their studies was relatively small (40 trials), application of their findings should be limited to the early stage of learning. Because one characteristic of the early stage of learning is cognitive information processing, the influence of the cognitive styles on the contextual interference effect in this stage is predictable. However, the influence of the cognitive styles in later stages of learning, where less cognitive demands are imposed on subjects, awaits for future research.

Another possible interaction concerns the contextual interference effect in cognitive activities without overt movements. Blandin, Proteau and Alain (1994), using an observational learning paradigm, found the contextual interference effect for observers who did not physically practice. Gabriele et al. (1989), Wright (1991) and Wright, Li and Whitacre (1992) imposed intervening cognitive activities on their subjects and found that certain types of cognitive activities facilitated learning. Although these findings are predicted in the early stage of learning where cognitive components of a task is the primary focus of processing, it is questionable whether these findings are applicable to
the later stage of learning where motor components of a task is more emphasized. It is clear that more research is necessary to answer this question.

Another consideration for future research is also related to the stages of learning. As Schmidt (1988) pointed out, most of the previous motor learning studies used only a limited number of practice trials. This has been the case for the contextual interference research, and it is therefore questionable whether the results of these studies can be applied to real world settings where thousands or millions of practice trials are performed (Newell, 1992). According to the model of learning stages proposed by Fitts (1964; Fitts & Posner, 1967), after a huge amount of practice attention demand to the task is decreased and the learner's response becomes automatic. Although Hall et al. (1994) demonstrated the contextual interference effect with highly skilled subjects who have years of experience on the task, more research is necessary to investigate the contextual interference effect when tasks are performed automatically.

Finally, although studies of contextual interference has traditionally focused on outcomes of skill performance, this outcome oriented approach to the contextual interference effect has been criticized by Newell (1992). He argued that the processes of developing coordination of movements under different levels of contextual interference need to be studies by looking at kinematics and kinetics of movements. Although the contextual interference effect has been explained from cognitive oriented viewpoints, such as the elaboration hypothesis (J. B. Shea & Morgan, 1979) and the action plan reconstruction hypothesis (Lee & Magill, 1985), little attention has been paid to whether different practice schedules produce different movement patterns. If movement kinematics or kinetics are analyzed, it should provide information about whether acquisition of coordinated movement patterns or refinement of movement parameters are influenced by different levels of contextual interference. This movement oriented approach should also provide an answer to the hypothesis proposed in the present study.
because what aspect of skill learning creates the contextual interference effect at what stage of learning would be clarified.
APPENDIX B: ADDITIONAL REFERENCES


G. E. Stelmach & J. Requin (Eds.), Tutorials in motor behavior (pp. 3-47). Amsterdam: North-Holland.


Whitehurst, M., & Del Rey, P. (1963). Effects of contextual interference, task
difficulty, and levels of processing on pursuit tracking. Perceptual and Motor Skills, 57,
619-628.

on the acquisition, retention, and transfer of simple motor skills. Research Quarterly for
Exercise and Sport, 62, 18-26.

and retention of motor skills. Journal of Motor Behavior, 23, 139-145.

processing to the contextual interference effect. Research Quarterly for Exercise and
Sport, 63, 30-37.


practice, retention, and transfer of an applied motor skill. Research Quarterly for Exercise
and Sport, 62, 406-412.

Wulf, G. (1992). Reducing knowledge of results can produce context effects in
movements of the same class. Journal of Human Movement Studies, 22, 71-84.

same class: Differential effects on program and parameter learning. Journal of Motor
Behavior, 25, 254-263.

retention and transfer through schema formation or context effects? Journal of Motor
Behavior, 20, 133-149.

and motor skill acquisition: On the processes that influence retention. Human Movement
Science, 12, 577-600.
May 3, 1995

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May 16, 1995

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Department of Kinesiology
Louisiana State University
112 Long Fieldhouse
Baton Rouge, LA 70803-7101

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My signature, on this sheet, by which I volunteer to participate in the experiment conducted by Hiroshi Sekiya indicates that I understand that all subjects in the experiment are volunteers, that I can withdraw at any time from the experiment, that I have been or will be informed as to the nature of the experiment, that the data I provide will be anonymous and my identity will not be revealed without my permission, and that my performance in this experiment may be used for additional approved projects. Finally, I shall be given an opportunity to ask question prior to the start of the experiment and after my participation is complete.

Date:
Name:
Signature:
APPENDIX E: INSTRUCTIONS FOR EACH EXPERIMENT

Instruction for Experiments 1 and 2

• The task is to tap four buttons so that movement times (MTs) between the buttons match goal MTs as closely as possible.
• Prior to each trial, you will see the goal MTs for each movement segment on the computer screen.
• After you see the goal MTs on the screen, start hitting the buttons clockwise. The first button you hit is one closest to you.
• After hitting the last button, MTs for each movement segment, which you just created, will be shown along the goal MTs on the screen.
• There will be 3 different goal MT patterns. Today, you will have 270 trials in total, 90 trials on each pattern. There will be a short break after every 30 trials.
• We are interested in how much you improve, so please try to reduce discrepancies between the goal MTs and your MTs as much as possible.
• If you have questions, ask the experimenter now and have 3 practice trials.

Instruction for Experiment 3

• The task is to move the mouse forward and backward along its track so that your movement pattern matches a goal movement pattern as closely as possible.
• Prior to each trial, you will see the goal movement pattern on the computer screen. The pattern represents a time-amplitude diagram, x-axis indicating time and y-axis indicating amplitude of the mouse movements.
• After the pattern disappears, a line will move down the left side of the screen. As soon as it reaches the bottom, you will begin your movement.
• After the movement, the pattern that you produced will be superimposed over the goal pattern. In addition, an error score will be shown on the screen.
• There will be 3 different goal patterns. Today, you will have 270 trials in total, 90 trials on each pattern. There will be a short break after every 30 trials.
• We are interested in how much you improve, so please try to reduce the error scores as much as possible.

• If you have questions, ask the experimenter now and have 3 practice trials.

**Instruction for Experiment 4**

• The task is to move the right-arm lever outward, inward, then outward again so that your movement pattern matches a goal movement pattern as closely as possible.

• Prior to each trial, you will see the goal movement pattern on the computer screen. The pattern represents a time-amplitude diagram, x-axis indicating time and y-axis indicating displacement of the lever movements.

• To begin each trial, move the lever so that a lever cursor (red "+" mark) is located in a green circle on the screen. Then you will hear two beeps in a row.

• Initiate the movement when you think you should hear an imaginary third beep, though you will actually never hear the third beep. An interval between the first and second beeps is equal to an interval between the second and third beeps.

• After the movement, the pattern you produced will be superimposed over the goal pattern. In addition, an error score will be shown on the screen.

• There will be 3 different goal patterns. Today, you will have 60 trials, 20 trials on each pattern. There will be a short break after every 20 trials.

• We are interested in how much you improve, so please try to reduce the error scores as much as possible.

• If you have questions, ask the experimenter now and have 5 practice trials.
APPENDIX F: CHAPTER 2 EXPERIMENT 1 DATA AND ANOVA TABLES

Table F.1. Mean Total Variability of Global Timing Performance during Acquisition and Retention in Experiment 1

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Table F. 2. ANOVA Table for Mean Total Variability of Global Timing Performance during Acquisition in Experiment 1

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Table F. 3. ANOVA Table for Mean Total Variability of Global Timing Performance during Retention in Experiment 1

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Table F. 5. **ANOVA Table for Mean Total Variability of Relative Timing Performance during Acquisition in Experiment 1**

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**APPENDIX G: CHAPTER 2 EXPERIMENT 2 DATA AND ANOVA TABLES**

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G-G Epsilon TB  .526

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Table G. 5. ANOVA Table for Mean Total Variability of Relative Timing Performance during Acquisition in Experiment 2

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Table G. 6. ANOVA Table for Mean Total Variability of Relative Timing Performance during Retention in Experiment 2

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Table G. 8. ANOVA Table for Mean Total Variability of Overall Duration Performance during Acquisition in Experiment 2

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Table G. 9. ANOVA Table for Mean Total Variability of Overall Duration Performance during Retention in Experiment 2

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Table H. 2. ANOVA Table for the Number of Excluded Trials during Acquisition in Experiment 3

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G-G Epsilon Session 1.000
TB .647
Session*TB .660

Table H. 3. ANOVA Table for the Number of Excluded Trials during Retention in Experiment 3

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G-G Epsilon Session 1.000
Table H. 4. Mean Root Mean Square Error during Acquisition and Retention in Experiment 3

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### Table H. 5. ANOVA Table for Root Mean Square Error during Acquisition in Experiment 3

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G-G Epsilon:  
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- TB: .682  
- Session*TB: .518

### Table H. 6. ANOVA Table for Root Mean Square Error during Retention in Experiment 3

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Table H.7. Mean Absolute Constant Error of Relative Mean Velocity during Acquisition and Retention in Experiment 3

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Table H.10. Mean Variable Error of Relative Mean Velocity during Acquisition and Retention in Experiment 3
Table H.11. ANOVA Table for Variable Error of Relative Mean Velocity during Acquisition in Experiment 3

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O-G Epsilon  
TB  
Session*TB  .711

Table H.12. ANOVA Table for Variable Error of Relative Mean Velocity during Retention in Experiment 3

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Table H. 14. ANOVA Table for Absolute Constant Error of Overall Mean Velocity during Acquisition in Experiment 3

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G-G Epsilon Session 1.000
TB .418
Session*TB .417

Table H. 15. ANOVA Table for Absolute Constant Error of Overall Mean Velocity during Retention in Experiment 3

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G-G Epsilon Session 1.000
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Table H.17. ANOVA Table for Variable Error of Overall Mean Velocity during Acquisition in Experiment 3

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G-G Epsilon
- Session 1.000
- TB .395
- Session*TB .465

Table H.18. ANOVA Table for Variable Error of Overall Mean Velocity during Retention in Experiment 3

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G-G Epsilon
- Session 1.000
Table H. 19. Mean Absolute Constant Error of Relative Timing during Acquisition and Retention in Experiment 3

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Table H. 23. ANOVA Table for Variable Error of Relative Timing during Acquisition in Experiment 3

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Session*TB .679

Table H. 24. ANOVA Table for Variable Error of Relative Timing during Retention in Experiment 3

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Session 1.000
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### Table H. 26. ANOVA Table for Absolute Constant Error of Overall Duration during Acquisition in Experiment 3

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### Table H. 27. ANOVA Table for Absolute Constant Error of Overall Duration during Retention in Experiment 3

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**Table H.28. Mean Variable Error of Overall Duration during Acquisition and Retention in Experiment 3**
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### Table H. 30. ANOVA Table for Variable Error of Overall Duration during Retention in Experiment 3

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### APPENDIX I: CHAPTER 4 EXPERIMENT 4 DATA AND ANOVA TABLES

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Table 1.2. ANOVA Table for the Number of Excluded Trials during Acquisition in Experiment 4

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Table 1.3. ANOVA Table for the Number of Excluded Trials during Retention in Experiment 4

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Table 1.4. ANOVA Table for the Number of Excluded Trials during Transfer in Experiment 4

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Table 1.5. Mean Root Mean Square Error during Acquisition, Retention and Transfer in Experiment 4

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Table 1.6. ANOVA Table for Root Mean Square Error during Acquisition in Experiment 4

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G-G Epsilon: Session .816
TB 1.000
Session * TB .993

Table 1.7. ANOVA Table for Root Mean Square Error during Retention in Experiment 4

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G-G Epsilon: Session .986

Table 1.8. ANOVA Table for Root Mean Square Error during Transfer in Experiment 4

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G-G Epsilon: Session .961
## Table 1.9: Mean Absolute Constant Error of Relative Timing during Acquisition, Retention and Transfer in Experiment 4

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### Notes:
- Table 1.9 displays the mean absolute constant error of relative timing across different conditions in Experiment 4, covering acquisition (Acqui), retention (Ret), and transfer (Trans) stages.
- The table entries represent error values with units likely in milliseconds.
- Each row indicates a specific subject condition, with columns detailing error values at various time blocks (TBl1, TBl2, etc.) and retention periods (Ret1, Ret2, etc.).
### Table I. 10. ANOVA Table for Absolute Constant Error of Relative Timing during Acquisition in Experiment 4

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G-G Epsilon: Session .871
TB 1.000
Session*TB .983

### Table I. 11. ANOVA Table for Absolute Constant Error of Relative Timing during Retention in Experiment 4

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G-G Epsilon: Session .973

### Table I. 12. ANOVA Table for Absolute Constant Error of Relative Timing during Transfer in Experiment 4

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G-G Epsilon: Session .874
Table 1.13. Mean Variable Error of Relative Timing during Acquisition, Retention and Transfer in Experiment 4

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### Table I.14. ANOVA Table for Variable Error of Relative Timing during Acquisition in Experiment 4

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G-G Epsilon: Session .934
TB 1.000
Session*TB .920

### Table I.15. ANOVA Table for Variable Error of Relative Timing during Retention in Experiment 4

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G-G Epsilon: Session .901

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G-G Epsilon: Session .952
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Table 1.18. ANOVA Table for Absolute Constant Error of Overall Duration during Acquisition in Experiment 4

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G-G Epsilon Session .923
TB 1.000
Session*TB .975

Table 1.19. ANOVA Table for Absolute Constant Error of Overall Duration during Retention in Experiment 4

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G-G Epsilon Session .676

Table 1.20. ANOVA Table for Absolute Constant Error of Overall Duration during Transfer in Experiment 4

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G-G Epsilon Session .914
**Table 1.21. Mean Variable Error of Overall Duration during Acquisition, Retention and Transfer in Experiment 4**

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**Table 1.22. ANOVA Table for Variable Error of Overall Duration during Acquisition in Experiment 4**

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G-G Epsilon

- Session : .993
- TB : 1.000
- Session*TB : .946

**Table 1.23. ANOVA Table for Variable Error of Overall Duration during Retention in Experiment 4**

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G-G Epsilon

- Session : .829

**Table 1.24. ANOVA Table for Variable Error of Overall Duration during Transfer in Experiment 4**

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G-G Epsilon

- Session : .924
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Note: The table continues with more data entries.
Table I. 26. ANOVA Table for Absolute Constant Error of Relative Average Angular Acceleration during Acquisition in Experiment 4

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G-G Epsilon: Session .867
TB 1.000
Session*TB .956

Table I. 27. ANOVA Table for Absolute Constant Error of Relative Average Angular Acceleration during Retention in Experiment 4

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G-G Epsilon: Session .865

Table I. 28. ANOVA Table for Absolute Constant Error of Relative Average Angular Acceleration during Transfer in Experiment 4

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G-G Epsilon: Session .878
Table 1. Mean Variable Error of Relative Average Angular Acceleration during Acquisition, Retention and Transfer in Experiment 4

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<th>Acqui 3</th>
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<th>Ret 2</th>
<th>Ret 3</th>
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Table I.30. ANOVA Table for Variable Error of Relative Average Angular Acceleration during Acquisition in Experiment 4

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TB 1.262 2.862 5.547 .0278 .0278
TB*Acq.Cnd. 1 .026 .026 .051 .8240 .8240
TB*Subject( Group) 22 11.350 .516
Session*TB 2 1.174 .587 .869 .4264 .4255
Session*TB*Acq.Cnd. 2 .925 .462 .685 .5096 .5083
Session*TB*Subject( Group) 44 29.724 .676

G-G Epsilon  Session .980
          TB 1.000
          Session*TB .990

Table I.31. ANOVA Table for Variable Error of Relative Average Angular Acceleration during Retention in Experiment 4

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G-G Epsilon  Session .906

Table I.32. ANOVA Table for Variable Error of Relative Average Angular Acceleration during Transfer in Experiment 4

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G-G Epsilon  Session .976
Table 1.33. Mean Absolute Constant Error of Overall Average Angular Acceleration during Acquisition, Retention and Transfer in Experiment 4

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<td>Tran 2</td>
<td>Tran 3</td>
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</tbody>
</table>

The table presents the mean absolute constant error of overall average angular acceleration during acquisition, retention, and transfer in Experiment 4. The data is organized in a table with columns for subject, condition, sex, acquisition, retention, and transfer. Each row represents a different combination of these factors, with specific values for the mean absolute constant error.
Table 1.34. ANOVA Table for Absolute Constant Error of Overall Average Angular Acceleration during Acquisition in Experiment 4

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G-G Epsilon Session         .924
TB                            1.000
Session*TB                    .767

Table 1.35. ANOVA Table for Absolute Constant Error of Overall Average Angular Acceleration during Retention in Experiment 4

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G-G Epsilon Session         .792

Table 1.36. ANOVA Table for Absolute Constant Error of Overall Average Angular Acceleration during Transfer in Experiment 4

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G-G Epsilon Session         .953
Table 1. 37. Mean Variable Error of Overall Average Angular Acceleration during Acquisition, Retention and Transfer in Experiment 4

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Notes on Table 1.37:
- The table presents the mean variable error of overall average angular acceleration during acquisition, retention, and transfer in Experiment 4.
- Each row represents a subject, with columns indicating conditions, sex, and the mean error values for different acquisition, retention, and transfer stages.
- The values are rounded to two decimal places.
- The table is structured in a clear format, providing a comprehensive view of the data collected.
### Table 1.38. ANOVA Table for Variable Error of Overall Average Angular Acceleration during Acquisition in Experiment 4

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G-G Epsilon Session: .862
TB: 1.000
Session*TB: .920

### Table 1.39. ANOVA Table for Variable Error of Overall Average Angular Acceleration during Retention in Experiment 4

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G-G Epsilon Session: .825

### Table 1.40. ANOVA Table for Variable Error of Overall Average Angular Acceleration during Transfer in Experiment 4

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G-G Epsilon Session: .995
Figure J.1. Mean number of excluded trials during three acquisition, retention and transfer sessions in Experiment 4.
Figure J. 2. Mean absolute constant error of relative timing during three acquisition, retention and transfer sessions in Experiment 4.
Figure 4.3. Mean variable error of relative timing during three acquisition, retention and transfer sessions in Experiment 4.
Figure 1.4. Mean variable error of overall duration during three acquisition, retention and transfer sessions in Experiment 4.
Figure J. 5. Mean absolute constant error of relative average angular acceleration during three acquisition, retention and transfer sessions in Experiment 4.
Figure 1.6. Mean variable error of relative average angular acceleration during three acquisition, retention and transfer sessions in Experiment 4.
Figure 1.7. Mean variable error of overall average angular acceleration during three acquisition, retention and transfer sessions in Experiment 4.
APPENDIX K: COMPUTER PROGRAMS FOR CHAPTER 2 EXPERIMENTS 1 AND 2

10 "***************************************************************
20 "** Contextual Interference Experiments 1 and 2
30 "** Data Acquisition Program
40 "** Programmed by Hiroshi Sekiya
50 "***************************************************************

100 CLEAR : CLS : KEY OFF: DEF SEG = &H6000: DIM A(3, 90, 3)
110 INPUT "Name": N$: INPUT "Age": AGE: V$ = DATES: T$ = TIMES
120 PRINT: PRINT "Male —> 1": PRINT "Female —> 2": LOCATE 5, 30: INPUT "SEX": SEX
130 PRINT: PRINT "Same MP —> 1": PRINT "Different MP —> 2": LOCATE 8, 30: INPUT "EXPERIMENT": EX
140 PRINT: PRINT "B—B —> 1": PRINT "B—S —> 2": PRINT "B—RS —> 3": PRINT "S—B —> 4": PRINT "S—S —> 5": PRINT "S—RS —> 6": PRINT "Conditions": COND
150 LOCATE 18, 30 INPUT "Order": ORDER: V = ORDER
210 REM****************** INITIALIZE*******************************
220 BLOAD "C:\METRABYTDASOM\N", 0
230 DASG = 0: DIM D%(16): MD% = 0: D%(0) = &H300: FLAG% = 0
240 CALL DASG(MD%, D%(0), FLAG%)
250 IF FLAG% <> 0 THEN PRINT "ERROR ": MD% = 0: D%(0) = &H300: FLAG% = 0
260 REM****************** CONDITIONS*******************************
270 DIM G1(3), G2(3), G3(3)
275 IF EX = 2 GOTO 310
280 G1(1) = 225: G2(1) = 150: G3(1) = 300
290 G1(2) = 300: G2(2) = 200: G3(2) = 400
300 G1(3) = 375: G2(3) = 250: G3(3) = 500
303 GOTO 320
305 REM******** DIFFERENT MP ********
310 G1(1) = 300: G2(1) = 225: G3(1) = 150
311 G1(2) = 300: G2(2) = 200: G3(2) = 400
312 G1(3) = 250: G2(3) = 500: G3(3) = 375
320 IF COND >= 4 GOTO 500
330 REM******** BLOCK CONDITION *******************************
340 IF V > 3 THEN V = 1
350 FOR Y = 1 TO 90
360 CLS : S1 = TIMER: KEY(1) OFF: CANCEL = 0: D%(0) = &H300: FLAG% = 0
365 PRINT "Trial ": B = 90 + Y
370 LOCATE 10, 20: PRINT G1(V)
380 LOCATE 10, 35: PRINT G2(V)
390 LOCATE 10, 50: PRINT G3(V)
392 BEEP
400 GOSUB 1000
402 ON KEY(1) GOSUB 2000
403 KEY(1) ON
405 K2 = TIMER
406 IF K2 = K1 < 5 THEN 405 ELSE CLS
410 S3 = TIMER
420 IF S3 - S1 < 12 GOTO 410
425 IF CANCEL = 1 GOTO 360
430 A(V, Y, 1) = MT1: A(V, Y, 2) = MT2: A(V, Y, 3) = MT3
440 NEXT Y
441 B = B + 1: IF B >= 3 GOTO 3000
443 CLS : PRINT "Let's take a break for one minute!"
444 B1 = TIMER
446 B2 = TIMER
448 IF B2 - B1 < 6  GOTO 446
450 V = V + 1: GOTO 340
500 REM******** SERIAL CONDITION ************
510 FOR Y = 1 TO 90
520 FOR X = 1 TO 3
525 IF V > 3 THEN V = 1
540 CLS: S1 = TIMER: KEY(1) OFF: CANCEL = 0: D%(0) = &H300: FLAG% = 0
545 PRINT "Trial #", Y * 3 - 3 + X
550 LOCATE 10, 20: PRINT GI(V)
560 LOCATE 10, 35: PRINT G2(V)
570 LOCATE 10, 50: PRINT G3(V)
590 BEEP
600 GOSUB 1000
602 ON KEY(1) GOSUB 2000
605 KEY(1) ON
606 K2 = TIMER
608 IF K2 - K1 < 5 THEN 606 ELSE CLS
610 S3 = TIMER
620 IF S3 - S1 < 12 GOTO 620
625 IF CANCEL = 1 THEN 620
630 A(V, Y, 1) = MT1: A(V, Y, 2) = MT2: A(V, Y, 3) = MT3
640 V = V + 1: NEXT X
650 IF Y = 30 OR Y = 60 THEN 660 ELSE 690
660 B1 = TIMER: CLS: PRINT "Let's take a break for one minute!"
670 B2 = TIMER
680 IF B2 - B1 < 60 GOTO 670
690 NEXT Y
700 GOTO 3000
1000 REM*************** T1 ****************
1010 MD% = 14
1020 CALL DASG(MD%, D%(1), FLAG%)
1030 IF D%(1) = 14 THEN 1040 ELSE 1010
1040 T1 = TIMER
1050 REM*************** T2 ****************
1060 MD% = 14
1070 CALL DASG(MD%, D%(1), FLAG%)
1080 IF D%(1) = 11 THEN 1090 ELSE 1060
1090 T2 = TIMER
1100 REM*************** T3 ****************
1110 MD% = 14
1120 CALL DASG(MD%, D%(1), FLAG%)
1130 IF D%(1) = 13 THEN 1140 ELSE 1110
1140 T3 = TIMER
1150 REM*************** T4 ****************
1160 MD% = 14
1170 CALL DASG(MD%, D%(1), FLAG%)
1180 IF D%(1) = 7 THEN 1190 ELSE 1160
1190 T4 = TIMER
1200 REM*************** MT ****************
1210 MT1 = (T2 - T1) * 1000: MT2 = (T3 - T2) * 1000: MT3 = (T4 - T3) * 1000
1212 R1 = TIMER
1214 R2 = TIMER
1216 IF R2 - R1 < 1 GOTO 1214
1220 COLOR 2: K1 = TIMER
1230 LOCATE 12, 20: PRINT USING "####": MT1
1240 LOCATE 12, 35: PRINT USING "####": MT2
LOCATE 12, 50: PRINT USING "####": MT3
IF MT1 > 1000 THEN GOSUB 2000
IF MT2 > 1000 THEN GOSUB 2000
IF MT3 > 1000 THEN GOSUB 2000
COLOR 7: RETURN
2000 COLOR 4: LOCATE 15, 35: PRINT "CANCEL": CANCEL = 1: COLOR 7
RETURN
3000 REM******** DATA FILE ***********************************************
3100 CLS: LOCATE 10, 16: COLOR 3
3200 PRINT "Thank you very much! See you tomorrow.": COLOR 7: KEY ON
3220 IF EX = 2 GOTO 326
3240 F$ = N$ + " SMP": GOTO 320
3260 F$ = N$ + " DMP"
3300 OPEN F$ FOR OUTPUT AS #1
3400 PRINT #1, N$: PRINT #1, AGE: PRINT #1, SEX
3500 PRINT #1, V$: PRINT #1, T$
3600 PRINT #1, EX; COND; ORDER
3700 FOR V = 1 TO 3
3800 FOR Y = 1 TO 90
3900 PRINT #1, A(V, Y, 1); A(V, Y, 2); A(V, Y, 3)
4100 NEXT Y
4200 NEXT V
4300 FOR V = 1 TO 3
4400 FOR Y = 91 TO 100
4500 INPUT#1, A(V, Y, 1); A(V, Y, 2); A(V, Y, 3)
4700 NEXT Y
4800 NEXT V
5000 DIM G1(3), G2(3), G3(3), GP1(3), GP2(3), GP3(3)
5100 IF EX = 2 GOTO 590
5200 G1(1) = 225: G2(1) = 150: G3(1) = 300
5300 G1(2) = 300: G2(2) = 200: G3(2) = 400
5400 G1(3) = 375: G2(3) = 250: G3(3) = 500
5500 GP1(1) = 3333333: GP2(1) = 2222222: GP3(1) = 4444444
5600 GP1(2) = 3333333: GP2(2) = 2222222: GP3(2) = 4444444
5700 GP1(3) = 3333333: GP2(3) = 2222222: GP3(3) = 4444444
224

380 GOTO 460

390 REM******** DIFFERENT MP ***************

400 G1(1)=300:G2(1)=225:G3(1)=150
410 G1(2)=300:G2(2)=200:G3(2)=400
420 G1(3)=250:G2(3)=500:G3(3)=375
430 GP1(1)=4444444:GP2(1)=3333333:GP3(1)=2222222
440 GP1(2)=3333333:GP2(2)=2222222:GP3(2)=4444444
450 GP1(3)=2222222:GP2(3)=4444444:GP3(3)=333333

460 REM******* PROPORTIONAL SCORE ************

470 FOR V=1 TO 3
480 FOR Y=1 TO 100
490 S=A(V,Y,1)+A(V,Y,2)+A(V,Y,3)
500 P(V,Y,1)=A(V,Y,1)/S:P(V,Y,2)=A(V,Y,2)/S:P(V,Y,3)=A(V,Y,3)/S
510 NEXT Y
520 NEXT V

530 REM******** AE *****************************************

540 FOR V=1 TO 3
550 FOR B=1 TO 10
555 AD1=0:AD2=0:AD3=0:PA1=0:PA2=0:PA3=0
560 FOR T=1 TO 10
570 AD1=AD1+ABS(A(V,B*10+T,1)-G1(V))
580 AD2=AD2+ABS(A(V,B*10+T,2)-G2(V))
590 AD3=AD3+ABS(A(V,B*10+T,3)-G3(V))
600 PA1=PA1+ABS(P(V,B*10+T,1)-GP1(V))
610 PA2=PA2+ABS(P(V,B*10+T,2)-GP2(V))
620 PA3=PA3+ABS(P(V,B*10+T,3)-GP3(V))
630 NEXT T
640 AE(V,B,1)=AD1/10:AE(V,B,2)=AD2/10:AE(V,B,3)=AD3/10
650 PAE(V,B,1)=PA1/10:PAE(V,B,2)=PA2/10:PAE(V,B,3)=PA3/10
660 NEXT B
670 NEXT V

680 REM******* CE & ACE *************

690 FOR V=1 TO 3
700 FOR B=1 TO 10
705 D1=0:D2=0:D3=0:PD1=0:PD2=0:PD3=0
710 FOR T=1 TO 10
720 D1=D1+A(V,B*10+T,1)-G1(V)
730 D2=D2+A(V,B*10+T,2)-G2(V)
740 D3=D3+A(V,B*10+T,3)-G3(V)
750 PD1=PD1+P(V,B*10+T,1)-GP1(V)
760 PD2=PD2+P(V,B*10+T,2)-GP2(V)
770 PD3=PD3+P(V,B*10+T,3)-GP3(V)
780 NEXT T
790 CE(V,B,1)=D1/10:ACE(V,B,1)=ABS(D1/10)
800 CE(V,B,2)=D2/10:ACE(V,B,2)=ABS(D2/10)
810 CE(V,B,3)=D3/10:ACE(V,B,3)=ABS(D3/10)
820 PCE(V,B,1)=PD1/10:PACE(V,B,1)=ABS(PD1/10)
830 PCE(V,B,2)=PD2/10:PACE(V,B,2)=ABS(PD2/10)
840 PCE(V,B,3)=PD3/10:PACE(V,B,3)=ABS(PD3/10)
850 NEXT B
860 NEXT V

870 REM****** VE ************************************

880 FOR V=1 TO 3
890 FOR B=1 TO 10
895 S1=0:S2=0:S3=0:PS1=0:PS2=0:PS3=0
900 FOR T=1 TO 10
910 S1=S1+A(V,B*10+T,1)
920 S2=S2+A(V,B*10+T,2)
930 S3=S3+A(V,B*10+T,3)
940 PS1=PS1+P(V,B*10+T,1)
950 PS2=PS2+P(V,B*10+T,2)
960 PS3=PS3+P(V,B*10+T,3)
970 NEXT T
980 NEV
990 NEXT V

1000 END
S3 = S3 + A(V,B*10-10+T,3)
P31 = P31 + P(V,B*10-10+T,1)
P32 = P32 + P(V,B*10-10+T,2)
P33 = P33 + P(V,B*10-10+T,3)
NEXT T
VA1 = 0; VA2 = 0; VA3 = 0; PVA1 = 0; PVA2 = 0; PVA3 = 0
FOR T=1 TO 10
VA1 = VA1 + (A(V,B*10-10+T,1)*S1/10)^2
VA2 = VA2 + (A(V,B*10-10+T,2)*S2/10)^2
VA3 = VA3 + (A(V,B*10-10+T,3)*S3/10)^2
PVA1 = PVA1 + (P(V,B*10-10+T,1)*PS1/10)^2
PVA2 = PVA2 + (P(V,B*10-10+T,2)*PS2/10)^2
PVA3 = PVA3 + (P(V,B*10-10+T,3)*PS3/10)^2
NEXT T
VE(V,B,1) = SQR(VA1/10)
VE(V,B,2) = SQR(VA2/10)
VE(V,B,3) = SQR(VA3/10)
PVE(V,B,1) = SQR(PVA1/10)
PVE(V,B,2) = SQR(PVA2/10)
PVE(V,B,3) = SQR(PVA3/10)
NEXT V
REM************ E ********************************************
FOR V=1 TO 3
FOR B=1 TO 10
E(V,B,1) = SQR((CE(V,B,1)^2 + VE(V,B,1)^2)
E(V,B,2) = SQR((CE(V,B,2)^2 + VE(V,B,2)^2)
E(V,B,3) = SQR((CE(V,B,3)^2 + VE(V,B,3)^2)
PE(V,B,1) = SQR((PE(V,B,1)^2 + PVE(V,B,1)^2)
PE(V,B,2) = SQR((PE(V,B,2)^2 + PVE(V,B,2)^2)
PE(V,B,3) = SQR((PE(V,B,3)^2 + PVE(V,B,3)^2)
NEXT B
NEXT V
REM************ MEAN (COLLAPSE THE SEGMENTS) ******************
DIM SMAE(3,10), SMACE(3,10), SMVE(3,10), SME(3,10)
DIM SMPAE(3,10), SMPACE(3,10), SMPVE(3,10), SMPME(3,10)
FOR V=1 TO 3
FOR B=1 TO 10
SMAE(V,B) = (AE(V,B,1)+AE(V,B,2)+AE(V,B,3))/3
SMACE(V,B) = (ACE(V,B,1)+ACE(V,B,2)+ACE(V,B,3))/3
SMVE(V,B) = (VE(V,B,1)+VE(V,B,2)+VE(V,B,3))/3
SMVE(V,B) = (VE(V,B,1)+VE(V,B,2)+VE(V,B,3))/3
SMPE(V,B) = (PE(V,B,1)+PE(V,B,2)+PE(V,B,3))/3
SMPE(V,B) = (PE(V,B,1)+PE(V,B,2)+PE(V,B,3))/3
NEXT B
NEXT V
REM************ MEAN (COLLAPSE THE TASK VERSIONS) *************
DIM VMACE(10), VMVE(10), VMPE(10)
DIM VMPAE(10), VMPACE(10), VMPVE(10), VMPE(10)
FOR B=1 TO 10
VMAE(B) = (SMAE(1,B)+SMAE(2,B)+SMAE(3,B))/3
VMACE(B) = (SMACE(1,B)+SMACE(2,B)+SMACE(3,B))/3
VMVE(B) = (SMVE(1,B)+SMVE(2,B)+SMVE(3,B))/3
VMPE(B) = (SMPE(1,B)+SMPE(2,B)+SMPE(3,B))/3
NEXT B
NEXT V
226

1500 VMPVE(B)=(SMPVE(1,B)+SMPVE(2,B)+SMPVE(3,B))/3
1510 VMPE(B)=(SMPE(1,B)+SMPE(2,B)+SMPE(3,B))/3
1520 NEXT B
1530 REM*************** PRINT OUT ******************************************
1600 GOSUB 4000
1610 LPRINT:LPRINT"*************** AE *******************"
1700 FOR V=1 TO 3
1710 GOSUB 3000
1730 FOR B=1 TO 10
1740 LPRINT USING"### ##
","B,AE(V,B,1),AE(V,B,2),AE(V,B,3),SMAE(V,B)
1750 NEXT B
1770 NEXT V
1773 OOSUB 5000
1775 GOSUB 4000
1780 LPRINT:LPRINT"*************** CE ********************"
1790 FOR V=1 TO 3
1810 GOSUB 3000
1820 FOR B=1 TO 10
1830 LPRINT USING"### ##
","B,CE(V,B,1),CE(V,B,2),CE(V,B,3)
1840 NEXT B
1860 NEXT V
1863 GOSUB 5000
1865 GOSUB 4000
1870 LPRINT:LPRINT"*************** ACF ********************"
1880 FOR V=1 TO 3
1890 GOSUB 3000
1900 FOR B=1 TO 10
1910 LPRINT USING"### ##
","B,ACF(V,B,1),ACF(V,B,2),ACF(V,B,3),SMACF(V,B)
1920 NEXT B
1930 NEXT V
1933 GOSUB 5000
1935 GOSUB 4000
1940 LPRINT:LPRINT"*************** VE  *******************"
1950 FOR V=1 TO 3
1960 GOSUB 3000
1970 FOR B=1 TO 10
1980 LPRINT USING"### ##
","B,VE(V,B,1),VE(V,B,2),VE(V,B,3),SMVE(V,B)
1990 NEXT B
2000 NEXT V
2003 GOSUB 5000
2005 GOSUB 4000
2010 LPRINT:LPRINT"*************** E  *******************"
2020 FOR V=1 TO 3
2030 GOSUB 3000
2040 FOR B=1 TO 10
2050 LPRINT USING"### ##
","B,E(V,B,1),E(V,B,2),E(V,B,3),SME(V,B)
2060 NEXT B
2070 NEXT V
2073 GOSUB 5000
2075 GOSUB 4000
2080 LPRINT:LPRINT"*************** PROPORTIONAL AE ********************"
2090 FOR V=1 TO 3
2100 GOSUB 3000
2110 FOR B=1 TO 10
2120 LPRINT USING"### ##
","B,PAE(V,B,1),PAE(V,B,2),PAE(V,B,3),SMPAE(V,B)
2130 NEXT B
2140 NEXT V
2143 GOSUB 5000
227

2145 GOSUB 4000
2150 LPRINT: LPRINT********** PROPORTIONAL CE **********
2160 FOR V=1 TO 3
2170 GOSUB 3000
2180 FOR B=1 TO 10
2190 LPRINT USING "## PCE(V,B,1),PCE(V,B,2),PCE(V,B,3)"
2200 NEXT B
2210 NEXT V
2213 GOSUB 5000
2215 GOSUB 4000
2218 LPRINT: LPRINT********** PROPORTIONAL ACE **********
2220 FOR V=1 TO 3
2230 GOSUB 3000
2235 FOR B=1 TO 10
2240 LPRINT USING "## PACE(V,B,1),PACE(V,B,2),PACE(V,B,3),SMPACE(V,B)"
2250 NEXT B
2260 NEXT V
2263 GOSUB 5000
2265 GOSUB 4000
2268 LPRINT: LPRINT********** PROPORTIONAL VE **********
2270 FOR V=1 TO 3
2280 GOSUB 3000
2285 FOR B=1 TO 10
2290 LPRINT USING "## VPE(V,B,1),VPE(V,B,2),VPE(V,B,3),SMPVE(V,B)"
2300 NEXT B
2310 NEXT V
2313 GOSUB 5000
2315 GOSUB 4000
2318 LPRINT: LPRINT********** PROPORTIONAL E **********
2320 FOR V=1 TO 3
2330 GOSUB 3000
2335 FOR B=1 TO 10
2340 LPRINT USING "## VPE(V,B,1),VPE(V,B,2),VPE(V,B,3),SMPVE(V,B)"
2350 NEXT B
2360 NEXT V
2363 GOSUB 5000
2365 GOSUB 4000
2368 LPRINT: LPRINT********** PROPORTIONAL E **********
2370 FOR V=1 TO 3
2380 GOSUB 3000
2385 FOR B=1 TO 10
2390 LPRINT USING "## E(V,B,1),E(V,B,2),E(V,B,3),SMP(E(V,B))"
2400 NEXT B
2410 NEXT V
2413 GOSUB 5000
2415 GOSUB 4000
2418 LPRINT: LPRINT********** PROPORTIONAL E **********
2420 FOR V=1 TO 3
2430 GOSUB 3000
2435 FOR B=1 TO 10
2440 LPRINT USING "## E(V,B,1),E(V,B,2),E(V,B,3),SMP(E(V,B))"
2450 NEXT B
2460 NEXT V
2463 GOSUB 5000
2465 GOSUB 4000
2468 LPRINT: LPRINT********** PROPORTIONAL E **********
2470 FOR B=1 TO 10
2480 LPRINT USING "## VMVE(B),VMAE(B),VMACE(B),VMPAE(B),VMPVE(B)"
2490 NEXT B
2493 GOSUB 5000
2495 GOSUB 4000
2498 LPRINT: LPRINT********** PROPORTIONAL E **********
2500 FOR B=1 TO 10
2510 LPRINT USING "## VMVE(B),VMAE(B),VMACE(B),VMPAE(B),VMPVE(B)"
2520 NEXT B
2523 GOSUB 5000
2525 GOSUB 4000
2530 END
3000 IF V=1 THEN LPRINT"TASK 1 (FAST VERSION)"
3010 IF V=2 THEN LPRINT"TASK 2 (MEDIUM VERSION)"
3020 IF V=3 THEN LPRINT"TASK 3 (SLOW VERSION)"
3025 LPRINT: LPRINT"TRIAL BLOCK","MT1","MT2","MT3","MEAN"
3030 RETURN
4000 IF EX=2 GOTO 4020
4010 LPRINT"EXPERIMENT*.EX,* (SAME MOTOR PROGRAM)" GOTO 4030
4020 LPRINT"EXPERIMENT*.EX,* (DIFFERENT MOTOR PROGRAM)"
4030 LPRINT: IF SEX = 2 GOTO 4050
4040 LPRINT: "Subject: NS TAB(30) "Age: " AGE, "Male": GOTO 4060
4050 LPRINT: "Subject: NS TAB(30) "Age: " AGE, "Female"
4060 IF COND = 1 THEN LPRINT "B-B Condition"
4070 IF COND = 2 THEN LPRINT "B-S Condition"
4080 IF COND = 3 THEN LPRINT "B-RS Condition"
4090 IF COND = 4 THEN LPRINT "B Condition"
4100 IF COND = 5 THEN LPRINT "S-B Condition"
4110 IF COND = 6 THEN LPRINT "S-RS Condition"
4120 IF ORDER = 1 THEN LPRINT "Task order: ABC"
4130 IF ORDER = 2 THEN LPRINT "Task order: BCA"
4140 IF ORDER = 3 THEN LPRINT "Task order: CAB"
4150 RETURN
5000 FOR I = 1 TO 17
5010 LPRINT
5020 NEXT I
5030 RETURN

10 **************************** Contextual Interference Experiment 1 and 2 ****************************
20 **************************** Error Calculation Program for Overall Duration Performance ****************************
30 **************************** Programmed by Hiroshi Sekiya ****************************
50 **************************** Contextual Interference Experiment 1 and 2 ****************************

100 CLEAR: CLS
110 DIM AG(3, 100), AS(3, 100), GS(3)
120 DIM AE(3, 10), CE(3, 10), ACE(3, 10), VE(3, 10), E(3, 10)
140 INPUT "FILE NAME": F$
150 OPEN F$ FOR INPUT AS #1
160 INPUT #1, NS$: INPUT #1, AGE, INPUT #1, SEX
170 INPUT #1, VS$: INPUT #1, TS$
180 INPUT #1, EX, COND, ORDER
190 FOR V = 1 TO 3
200 FOR Y = 1 TO 90
210 INPUT #1, A(V, Y, 1), A(V, Y, 2), A(V, Y, 3)
220 NEXT Y
230 NEXT V
240 FOR V = 1 TO 3
250 FOR Y = 91 TO 100
260 INPUT #1, A(V, Y, 1), A(V, Y, 2), A(V, Y, 3)
270 NEXT Y
280 NEXT V
285 CLOSE #1
290 DIM G1(3), G2(3), G3(3), GP1(3), GP2(3), GP3(3)
300 IF EX = 2 GOTO 390
310 REM **************************** SAME MP ****************************
320 G1(1) = 225: G2(1) = 150: G3(1) = 300
330 G1(2) = 300: G2(2) = 200: G3(2) = 400
340 G1(3) = 375: G2(3) = 250: G3(3) = 500
380 GOTO 460
390 REM **************************** DIFFERENT MP ****************************
400 G1(1) = 300: G2(1) = 225: G3(1) = 150
410 G1(2) = 300: G2(2) = 200: G3(2) = 400
420 G1(3) = 250: G2(3) = 500: G3(3) = 375
460 REM **************************** OVERALL DURATION SCORE ****************************
470 FOR V = 1 TO 3
475 GS(V) = G1(V) + G2(V) + G3(V)
480 FOR Y = 1 TO 100
490 S(V, Y) = A(V, Y, 1) + A(V, Y, 2) + A(V, Y, 3)
510 NEXT Y
520 NEXT V
530 REM******** AE ****************************************
540 FOR V = 1 TO 3
550 FOR B = 1 TO 10
555 AD = 0
560 FOR T = 1 TO 10
567 AD = AD + ABS(S(V, B * 10 + T) - GS(V))
570 NEXT T
580 FOR V = 1 TO 3
590 FOR B = 1 TO 10
600 FOR T = 1 TO 10
610 AD = AD + S(V, B * 10 + T) - GS(V)
620 NEXT T
630 AE(V, B) = AD / 10
640 NEXT B
650 NEXT V
660 REM******** CE & ACE ****************************************
670 FOR V = 1 TO 3
680 FOR B = 1 TO 10
690 D = 0
700 FOR T = 1 TO 10
710 D = D + S(V, B * 10 + T) - GS(V)
720 NEXT T
730 CE(V, B) = D / 10: ACE(V, B) = ABS(D / 10)
740 NEXT B
750 NEXT V
760 REM******** VE ****************************************
770 FOR V = 1 TO 3
780 FOR B = 1 TO 10
790 SU = 0
800 FOR T = 1 TO 10
810 SU = SU + S(V, B * 10 + T)
820 NEXT T
830 VA = 0
840 FOR T = 1 TO 10
850 VA = VA + (S(V, B * 10 + T) - SU / 10)^2
860 NEXT T
870 VE(V, B) = SQR(VA / 10)
880 NEXT B
890 NEXT V
900 REM******** E ****************************************
910 FOR V = 1 TO 3
920 FOR B = 1 TO 10
930 E(V, B) = SQR(CE(V, B)^2 + VE(V, B)^2)
940 NEXT B
950 NEXT V
960 REM******** MEAN (COLLAPSE THE TASK VERSIONS) ********
970 DIM VMAE(10), VMACE(10), VMVE(10), VME(10)
980 DIM VMPAE(10), VMPACE(10), VMPPVE(10), VMPP(10)
990 FOR B = 1 TO 10
1000 VMAE(B) = (AE(1, B) + AE(2, B) + AE(3, B)) / 3
1010 VMACE(B) = (ACE(1, B) + ACE(2, B) + ACE(3, B)) / 3
1020 VMVE(B) = (VE(1, B) + VE(2, B) + VE(3, B)) / 3
1030 VME(B) = (E(1, B) + E(2, B) + E(3, B)) / 3
1040 NEXT B
1050 REM******** PRINT OUT **************************************************
1060 GOSUB 4000
1070 LPRINT: LPRINT "******* Overall Duration Error *************"
1080 FOR V = 1 TO 3
1090 FOR B = 1 TO 10
1100 LPRINT USING "###", B, AE(V, B); CE(V, B); ACE(V, B); VE(V, B); E(V, B)
1750 NEXT B
1770 NEXT V
1773 GOSUB 5000
1775 GOSUB 4000
2430 LPRINT: LPRINT
2440 LPRINT: "******************************"
2450 LPRINT: "******************************"
2460 LPRINT: "Trial Block AE ACE VE E"
2470 FOR B = 1 TO 10
2480 LPRINT USING "****", B; VMAE(B); VMACE(B); VMVE(B); VMVE(B)
2490 NEXT B
2540 END
3000 LPRINT
3005 IF V = 1 THEN LPRINT "TASK 1 (FAST VERSION)"
3010 IF V = 2 THEN LPRINT "TASK 2 (MEDIUM VERSION)"
3020 IF V = 3 THEN LPRINT "TASK 3 (SLOW VERSION)"
3025 LPRINT: LPRINT "Trial Block AE CE ACE VE E"
3030 RETURN
4000 IF EX = 2 GOTO 4020
4010 LPRINT "EXPERIMENT": EX; " (SAME MOTOR PROGRAM)"; GOTO 4030
4020 LPRINT "EXPERIMENT": EX; " (DIFFERENT MOTOR PROGRAM)"
4030 LPRINT: IF SEX = 2 GOTO 4050
4040 LPRINT "Subject: "; NS; TAB(30); "Age: "; AGE; "Male"; GOTO 4060
4050 LPRINT "Subject: "; NS; TAB(30); "Age: "; AGE; "Female"
4060 IF COND = 1 THEN LPRINT "B-B Condition"
4070 IF COND = 2 THEN LPRINT "B-S Condition"
4080 IF COND = 3 THEN LPRINT "B-RS Condition"
4090 IF COND = 4 THEN LPRINT "S-B Condition"
4100 IF COND = 5 THEN LPRINT "S-S Condition"
4110 IF COND = 6 THEN LPRINT "S-RS Condition"
4120 IF ORDER = 1 THEN LPRINT "Task order: ABC"
4130 IF ORDER = 2 THEN LPRINT "Task order: BCA"
4140 IF ORDER = 3 THEN LPRINT "Task order: CAB"
4150 RETURN
5000 FOR I = 1 TO 17
5010 LPRINT
5020 NEXT I
5030 RETURN
APPENDIX L: COMPUTER PROGRAMS FOR CHAPTER 3 EXPERIMENT 3

```
DECLARE FUNCTION BinStr2Bin% (B$)
DECLARE SUB Mouse (m1%, m2%, m3%, m4%)
DECLARE SUB MOUSERANGE (x1%, y1%, x2%, y2%)
DECLARE SUB MousePut (XMOUSE%, YMOUSE%)
DECLARE SUB Mouselnches (horizontal%, vertical%)
DECLARE SUB MouseInstnall (mflag%)
DECLARE SUB MousePressLeft (leftCount%, XMOUSE%, YMOUSE%)
DECLARE SUB MousePressRight (rightCount%, XMOUSE%, YMOUSE%)
DECLARE SUB MouseReleaseLeft (leftCount%, XMOUSE%, YMOUSE%)
DECLARE SUB MouseReleaseRight (rightCount%, XMOUSE%, YMOUSE%)
DECLARE SUB MouseNow (leftButton%, rightButton%, XMOUSE%, YMOUSE%)
CLEAR: SCREEN 8: CLS
    Mouselnches mflag%
    ' PRINT "Setting Mouse Inches to 8 by 9 (8 inches of mouse motion"
    ' PRINT "across desk to move across screen, and 9 inches vertical"
    ' PRINT "mouse motion from top to bottom of screen)."
    MOUSERANGE 0, 0, 639, 199: Mouselnches 8, 4.5
DIM V(1800) AS INTEGER
DIM AY(3,3) AS INTEGER
DIM HALEA(3, 3)
DIM TY(3, 1200) AS INTEGER
DIM TAR(300) AS INTEGER, MOU(300) AS INTEGER
DIM Y{3,90) AS INTEGER

******************************************************************************
* * * * * * * * MOUSE & TARGET IMAGE * * * * * * * * * * * * * * * * * * * * *
******************************************************************************
CLS : LINE (1, 1)-(5, 1), 10: GET (1, 1)-(5, 1), TAR: CLS
LINE (1, 1)-(5, 1), 12: GET (1, 1)-(5, 1), MOU: CLS

******************************************************************************
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
******************************************************************************

INPUT "NAME"; N$: PRINT
PRINT "SESSION"
PRINT " Acquisition --> 1"
INPUT " Retention --> 2" ; SESSION PRINT
IF SESSION = 2 THEN GOTO DREAD
PRINT "SEX"
PRINT " Male --> 1"
INPUT " Female --> 2" ; SEX: PRINT
PRINT "CONDITION"
PRINT " B-B --> 1"
PRINT " B-S --> 2"
PRINT " S-B --> 3"
INPUT " S-S --> 4 " ; COND: PRINT
PRINT "SEQUENCE"
PRINT " ABC --> 1"
PRINT " BCA --> 2"
INPUT " CAB --> 3 " ; SEQ: PRINT
PRINT "# of Trials"
PRINT " 90 --> 1"
INPUT " 270 --> 2 " ; NT: CLS

******************************************************************************

OPEN N$ + ".CG" FOR OUTPUT AS #1
WRITE #1, SEX, COND, SEQ, NT
CLOSE #1: GOTO YCO
```

DREAD:
OPEN N$ + "CIG" FOR INPUT AS #1
INPUT #1, SEX, COND, SEQ, NT
CLOSE #1: CLS

********** Y COORDINATES *******************************

YCO:
AY(1, 0) = 170; AY(1, 1) = 125; AY(1, 2) = 155; AY(1, 3) = 140
AY(2, 0) = 170; AY(2, 1) = 80; AY(2, 2) = 140; AY(2, 3) = 110
AY(3, 0) = 170; AY(3, 1) = 35; AY(3, 2) = 125; AY(3, 3) = 80

FOR P% = 1 TO 3

********** SEGMENT 1 ****************************

angle = 180 / 400: pi = 3.14159 / 180
A% = AY(P%, 1) - AY(P%, 0): HALFA(P%, 1) = A% / 2
FOR X% = 1 TO 400
  R = (X% * (angle)) * (pi)
  TY(P%, X%) = CINT(AY(P%, 0) + HALFA(P%, 1) - (HALFA(P%, 1) * COS(R)))
NEXT X%

********** SEGMENT 2 ****************************

angle = 180 / 600
A% = AY(P%, 2) - AY(P%, 1): HALFA(P%, 2) = A% / 2
FOR X% = 1 TO 600
  R = (X% * (angle)) * (pi)
  TY(P%, X% + 400) = CINT(AY(P%, 1) + HALFA(P%, 2) - (HALFA(P%, 2) * COS(R)))
NEXT X%

********** SEGMENT 3 ****************************

angle = 180 / 200
A% = AY(P%, 3) - AY(P%, 2): HALFA(P%, 3) = A% / 2
FOR X% = 1 TO 200
  R = (X% * (angle)) * (pi)
  TY(P%, X% + 1000) = CINT(AY(P%, 2) + HALFA(P%, 3) - (HALFA(P%, 3) * COS(R)))
NEXT X%

NEXT P%

IF SESSION = 1 THEN GOTO ACQUI ELSE GOTO RET

*.************************ ACQUISITION TRIAL.**

ACQUI:
IF NT = 1 THEN TN% = 30 ELSE TN% = 90
COLOR 3: PRINT
PRINT "The task is to move the mouse forward and backward along its track so that": PRINT
PRINT "your movement pattern matches a goal movement pattern as closely as possible." : PRINT
PRINT "Prior to each trial, you will see the goal movement pattern on the computer": PRINT
PRINT "screen. The pattern represents a Time-Amplitude diagram, x-axis indicating": PRINT
PRINT "time and y-axis indicating Amplitude of the mouse movements. After the": PRINT
PRINT "pattern disappears, a line will move down the left side of the screen.": PRINT
PRINT "As soon as it reaches the bottom, you will begin your movement. After the": PRINT
PRINT "movement, the pattern that you produced will be superimposed over the goal": PRINT
PRINT "pattern. In addition, an error score will be shown on the screen." : PRINT
PRINT : PRINT : PRINT
PRINT "Press any key to continue.
"
DO
LOOP WHILE INKEY$ = ""
CLS

******** DATA FILE *********

OPEN "GOMA.CIG" FOR INPUT AS #1
INPUT #1, GOMASEX, GOMACOND, GOMASEQ, GOMANT
FOR TRNO% = 1 TO 3
  FOR X% = 1 TO 90
    INPUT #1, Y(TRNO%, X%)
  NEXT X%
NEXT TRNO%
CLOSE #1
FOR TRNO% = 1 TO 3
CLS

********** PATTERNS **********
LINE (30, 170)-(80, 170), 10
FOR X% = 1 TO 1200
  PSET (CINT(X% / 4) + 80, TY(2, X%)), 10
NEXT X%
LINE (381, 110)-(481, 110), 10

********** KP **********
XX% = 0
FOR X% = 1 TO 1200 STEP 20
  XX% = XX% + 1
  PSET ((X% / 4) + 30, Y(TRNO%, XX%)), 12
NEXT X%

********** KR **********
E = 0, XX% = 0
FOR X% = 1 TO 1200 STEP 20
  XX% = XX% + 1
  DY = ABS(TY(2, X%) - Y(TRNO%, XX% + 10))
  E = E + DY
NEXT X%

LOCATE 1, 25
PRINT "Error = ";
PRINT USING "###.#": E / 60
IF TRNO% = 1 THEN
  LOCATE 20, 5: PRINT "This is an example of the goal movement pattern (green) and"
  LOCATE 21, 5: PRINT "the produced movement pattern (red). In this example, you"
  LOCATE 22, 5: PRINT "need to expand your movements."
ELSE IF TRNO% = 2 THEN
  LOCATE 21, 5: PRINT "In this example, you need to"
  LOCATE 22, 5: PRINT "shrink your movements."
ELSE
  LOCATE 22, 5: PRINT "In this example, you need to initiate your movements earlier."
END IF
LOCATE 23, 15: PRINT "Press any key to continue..."
DO
LOOP WHILE INKEY$ = ""
NEXT TRNO%
CLS: PRINT
PRINT "There will be 3 different goal patterns. Today, you will have": TN% * 3; "trials on each pattern. There will be a short break after": PRINT
PRINT "total, ": TN%, "trials in": PRINT
PRINT "every 30 trials. We are interested in how much you improve, so please": PRINT
PRINT "try to reduce the error scores as much as possible.": PRINT
PRINT
PRINT "Let's have 3 practice trials"
PRINT: PRINT: PRINT
PRINT "Press any key to continue..."
DO
LOOP WHILE INKEY$ = ""
CLS: COLOR 15
P% = 2
FOR TRNO% = 1 TO 3
  GOSUB TRIAL
NEXT TRNO%
CLS
PRINT "Press any key to begin."
DO
LOOP WHILE INKEYS = ""
CLS

'************************ DATA FILE ****************************
OPEN N$ + "CIO" FOR OUTPUT AS #1
WRITE #1, SEX, COND, SEQ, NT
CLOSE #1
IF COND <= 2 THEN GOTO BLOCK ELSE GOTO SERIAL

'************************ RETENTION TRIAL ****************************

RET:
CLS ; COLOR 3
PRINT
PRINT "Today you will have 30 trials on the same patterns that you practiced".
PRINT "Yesterday, however, you will not see the patterns after each trial.".
PRINT "So please remember how you performed yesterday.".
PRINT
PRINT : PRINT
DO
LOOP WHILE INKEYS = ""
CLS ; COLOR 15
TN% = 10
IF COND MOD 2 = 1 THEN GOTO BLOCK ELSE GOTO SERIAL

BLOCK:
FOR BL% = 1 TO 3
P% = SEQ + BL% - 1; IF P% > 3 THEN P% = P% - 3
FOR TR% = 1 TO TN%
TRNO% = (BL% - 1) * TN% + TR%
GOSUB TRIAL
IF TRNO% MOD 30 = 0 AND TRNO% < TN% * 3 THEN GOSUB BREAK
NEXT TR%
NEXT BL%
GOTO THANKS

SERIAL:
FOR TR% = 1 TO TN%
FOR PAT% = 1 TO 3
P% = SEQ + PAT% - 1; IF P% > 3 THEN P% = P% - 3
TRNO% = TR% * 3 - 3 + PAT%
GOSUB TRIAL
NEXT PAT%
IF TRNO% MOD 30 = 0 AND TRNO% < TN% * 3 THEN GOSUB BREAK
NEXT TR%

THANKS:
CLS ; COLOR 11
IF SESSION = 1 THEN
LOCATE 10, 20: PRINT "Thank you very much! See you tomorrow!"
ELSEIF SESSION = 2 THEN
LOCATE 10, 25: PRINT "Thank you very much! Bye!"
END IF
COLOR 15
END

BREAK:
BT1 = TIMER: CLS : LOCATE 10, 20: PRINT "Let's take a short break!"
DO: BT2 = TIMER. LOOP UNTIL BT2 - BT1 > 30: CLS : RETURN

'TRIAL.
TRIAL:
T0 = TIMER
LOCATE 1, 1: PRINT "Trial #"; TRNO%
LOCATE 2, 1
PRINT "Locate mouse to BOTTOM position and click left mouse button": BEEP
FOR J% = -1 TO 0
  DO
    MouseNow leftButton%, rightButton%, XMOUSE%, YMOUSE%
  LOOP UNTIL leftButton% = J%
NEXT J%
MousePut 80, 199
LOCATE 2, 1
PRINT "Locate red bar over green bar and click left mouse button"
  PUT (80, 170), TAR, XOR
FOR J% = -1 TO 0
  DO
    MouseNow leftButton%, rightButton%, XMOUSE%, YMOUSE%
    PUT (80, YMOUSE%), MOU, XOR
    PUT (80, YMOUSE%), MOU, XOR
  LOOP UNTIL leftButton% = J%
NEXT J%

*********** PATTERNS ****************************
IF P% = 1 THEN
  YY% = 140
ELSEIF P% = 2 THEN
  YY% = 110
ELSE
  YY% = 80
ENDIF
LINE (30, 170)-(80, 170), 10
FOR X% = 1 TO 1200
  PSET (INT(X% / 4) + 80, TY(Y%), X%)), 10
NEXT X%
LINE (381, YY%)-(480, YY%), 10
T1 = TIMER
DO: T2 = TIMER: LOOP UNTIL T2 - T1 > 1
SCREEN 8, 1, 1

*********** FORE PERIOD ****************************
LINE (0, 199)-(10, 199)
FOR I% = 1001 TO 1800
  PSET (5, X% / 10): FOR J% = 1 TO 118: NEXT J%
NEXT I%

*********** DATA ACQUISITION ***************************
FOR X% = 1 TO 1800
  PSET (5, X% / 10 + 180)
  MouseNow leftButton%, rightButton%, XMOUSE%, YMOUSE%
  Y(X%) = YMOUSE%
  FOR J% = 1 TO 95: NEXT J%
NEXT X%

*********** KR DELAY INTERVAL ****************************
F1% = 0: ON KEY(1) GOSUB KEYSUB: KEY(1) ON
T4 = TIMER: CLS: IF SESSION = 2 THEN GOTO NOKR
DO: T5 = TIMER: LOOP UNTIL T5 - T4 > 1

*********** KP ****************************
LINE (30, 170)-(80, 170), 10
FOR X% = 1 TO 1200
  PSET (INT(X% / 4) + 80, TY(Y%, X%)), 10
NEXT X%
LINE (381, YY%)-(480, YY%), 10
FOR X% = 1 TO 1800 STEP 20
    PSET ((X% / 4) + 30, V(X%)), 12
NEXT X%

FOR X% = 1 TO 1200 STEP 20
    DY = ABS(TY(P%, X%) - V(X% + 20))
    E = E + DY
NEXT X%

E = 0
FOR X% = 1 TO 1200 STEP 20
    DY = ABS(TY(P%, X%) - V(X% + 20))
    E = E + DY
NEXT X%

PRINT "Error = ";
PRINT USING "##,##0.00", E / 60

DO: T6 = TIMER: LOOP UNTIL T6 - T4 > 4
NOKR:
SCREEN 8, 1, 1: CLS: SCREEN 8, 0, 0: CLS: SCREEN 8, 0, 0
DO: LOOP UNTIL TIMER - T4 > 4
DO: T7 = TIMER: LOOP WHILE T7 - T0 < 12
IF F1% = 1 THEN GOTO TRIAL

DO: T6 = TIMER: LOOP UNTIL T6 - T4 > 4
NOKR:
SCREEN 8, 1, 1: CLS: SCREEN 8, 0, 0: CLS: SCREEN 8, 0, 0
DO: LOOP UNTIL TIMER - T4 > 4
DO: T7 = TIMER: LOOP WHILE T7 - T0 < 12
IF F1% = 1 THEN GOTO TRIAL

OPEN NS + "CIO" FOR APPEND AS #1
FOR X% = 1 TO 1800 STEP 20
    WRITE #1, V(X%)
NEXT X%
CLOSE #1
RETURN

KEYSUB:
F1% = 1
RETURN

** Name: MouseInches
** Type: Subprogram
** Module: MOUSSUBS.BAS
** Language: Microsoft QuickBASIC 4.00

Sets mouse motion ratio in inches per screen.

EXAMPLE OF USE: MouseInches horizontal%, vertical%

PARAMETERS: horizontal% Inches of horizontal mouse motion per
  screen width
  vertical% Inches of vertical% mouse motion per
  screen height

VARIABLES: h%  Calculated value to pass to mouse driver
  v%  Calculated value to pass to mouse driver

MODULE LEVEL

DECLARES: DECLARE SUB Mouse (m1%, m2%, m3%, m4%)
  DECLARE SUB MouseInches (horizontal%, vertical%)

SUB MouseInches (horizontal%, vertical%) STATIC
    IF horizontal% > 100 THEN
        horizontal% = 100
    END IF
    IF vertical% > 100 THEN
        vertical% = 100
    END IF
h% = horizontal% * 5 \ 2
V% = vertical% * 8
Mouse 15, 0, h%, V%
END SUB

******************************************************************************
** Name: MouseInstall **
** Type: Subprogram **
** Module: MOUSSUBS.BAS **
** Language: Microsoft QuickBASIC 4.00 **
******************************************************************************

Determine whether mouse is available and resets all mouse parameters.

EXAMPLE OF USE: MouseInstall mflag%
PARAMETERS: mflag% Returned indication of mouse availability
VARIABLES (none)
MODULE LEVEL
DECLARATIONS: DECLARE SUB Mouse (m1%, m2%, m3%, m4%)
DECLARE SUB MouseInstall (mflag%)

SUB MouseInstall (mflag%) STATIC
mflag% = 0
Mouse mflag%, 0, 0, 0
END SUB

******************************************************************************
** Name: MouseNow **
** Type: Subprogram **
** Module: MOUSSUBS.BAS **
** Language: Microsoft QuickBASIC 4.00 **
******************************************************************************

Returns the instantaneous state of the mouse.

EXAMPLE OF USE: MouseNow leftButton%, rightButton%, xMouse%, yMouse%
PARAMETERS: leftButton% Indicates left mouse button state
rightButton% Indicates right mouse button state
xMouse% X location of mouse
yMouse% Y location of mouse
VARIABLES: m2% Mouse driver parameter containing button press information
MODULE LEVEL
DECLARATIONS: DECLARE SUB Mouse (m1%, m2%, m3%, m4%)
DECLARE SUB MouseNow (leftButton%, rightButton%,
xMouse%, yMouse%)

SUB MouseNow (leftButton%, rightButton%, XMousse%, YMOUSE%) STATIC
Mouse 3, m2%, XMousse%, YMOUSE%
leftButton% = ((m2% AND 1) <> 0)
rightButton% = ((m2% AND 2) <> 0)
END SUB

******************************************************************************
** Name: MousePressLeft **
** Type: Subprogram **
** Module: MOUSSUBS.BAS **
** Language: Microsoft QuickBASIC 4.00 **
******************************************************************************

Returns the mouse state at last press of left button
EXAMPLE OF USE: MousePressLeft leftCount%, xMouse%, yMouse%

PARAMETERS:  leftCount%   Number of times the left button has been
             pressed since the last call to this
             subprogram
             xMouse%   X location of the mouse at the last press
             of the left button
             yMouse%   Y location of the mouse at the last press
             of the left button

VARIABLES:    m1%      Parameter for call to mouse driver

MODULE LEVEL
DECLARATIONS: DECLARE SUB MousePressLeft (leftCount%, xMouse%, yMouse%)

END SUB

EXAMPLE OF USE: MousePressRight rightCount%, xMouse%, yMouse%

PARAMETERS:  rightCount%  Number of times the right button has been
             pressed since the last call to this
             subprogram
             xMouse%   X location of the mouse at the last press
             of the right button
             yMouse%   Y location of the mouse at the last press
             of the right button

VARIABLES:    m1%      Parameter for call to mouse driver

MODULE LEVEL
DECLARATIONS: DECLARE SUB MousePressRight (rightCount%, xMouse%, yMouse%)

END SUB

EXAMPLE OF USE: MousePut xMouse%, yMouse%

PARAMETERS:  xMouse%   Horizontal location to place cursor
             yMouse%   Vertical location to place cursor

VARIABLES:    (none)

MODULE LEVEL
DECLARATIONS: DECLARE SUB MousePut (xMouse%, yMouse%)

END SUB

EXAMPLE OF USE: MouseRange xMouse%, yMouse%

PARAMETERS:  xMouse%   Horizontal location to place cursor
             yMouse%   Vertical location to place cursor

VARIABLES:    (none)

MODULE LEVEL
DECLARATIONS: DECLARE SUB MouseRange (xMouse%, yMouse%)

END SUB
Sets mouse range of motion.

EXAMPLE OF USE: MouseRange x1%, y1%, x2%, y2%

PARAMETERS:
- x1%  Upper left corner X coordinate
- y1%  Upper left corner Y coordinate
- x2%  Lower right corner X coordinate
- y2%  Lower right corner Y coordinate

VARIABLES: (none)

MODULE LEVEL

DECLARATIONS: DECLARE SUB Motwe (ml%, m2%, m3%, m4%)
DECLARE SUB MoueeRange(Jtl%, yl%, x2% , y2%)

SUB MOUSE RANGE (x1%, y1%, x2%, y2%) STATIC
Mouse 7, 0, x1%, x2%
Mouse 8, 0, y1%, y2%
END SUB

* * * Name: MouseReleaseLeft **
* * Type: Subprogram **
* * Module: MOUSSUBS.BAS **
* * Language: Microsoft QuickBASIC 4.00 **

Returns the mouse state at last release of left button.

EXAMPLE OF USE: MouseReleaseLeft leftCount%, xMouse%, yMouse%

PARAMETERS:
- leftCount%  Number of times the left button has been released since the last call to this subprogram
- xMouse%    X location of the mouse at the last release of the left button
- yMouse%    Y location of the mouse at the last release of the left button

VARIABLES: m1% Parameter for call to mouse driver

MODULE LEVEL

DECLARATIONS: DECLARE SUB Mouse (m1%, m2%, m3%, m4%)
DECLARE SUB MouseReleaseLeft (leftCount%, xMouse%, yMouse%)

SUB MouseReleaseLeft (leftCount%, XMUSE%, YMUSE%) STATIC
m1% = 6
leftCount% = 0
Mouse m1%, leftCount%, XMUSE%, YMUSE%
END SUB

* * * Name: MouseReleaseRight **
* * Type: Subprogram **
* * Module: MOUSSUBS.BAS **
* * Language: Microsoft QuickBASIC 4.00 **

Returns the mouse state at last release of right button.

EXAMPLE OF USE: MouseReleaseRight rightCount%, xMouse%, yMouse%

PARAMETERS:
- rightCount%  Number of times the right button has been released since the last call to this
subprogram
  xMouse%  X location of the mouse at the last release of the right button
  yMouse%  Y location of the mouse at the last release of the right button
' VARIABLES: m1%  Parameter for call to mouse driver
'MODULE LEVEL
' DECLARATIONS: DECLARE SUB Mouse (m1%, m2%, m3%, m4%)
  DECLARE SUB MouseReleaseLeft (leftCount%, xMouse%, yMouse%)
  DECLARE SUB MouseReleaseRight (rightCount%, XMOSUE%, YMOUSE%)
  m1%  = 6
  rightCount%  = 1
  Mouse m1%, rightCount%, XMOSUE%, YMOUSE%
END SUB

DECLARE FUNCTION BinStr2Bin% (B$)
DECLARE SUB Mouse (m1%, m2%, m3%, m4%)
DECLARE SUB MOUSERANGE (X1%, Y1%, X2%, Y2%)
DECLARE SUB MOUSEPUT (XMOSUE%, YMOUSE%)
DECLARE SUB MOUSEINCHES (horizontal%, vertical%)
DECLARE SUB MOUSEINSTALL (mflag%)
DECLARE SUB MOUSEPRESSLEFT (leftCount%, XMOSUE%, YMOUSE%)
DECLARE SUB MOUSEPRESSRIGHT (rightCount%, XMOSUE%, YMOUSE%)
DECLARE SUB MOUSERELEASELEFT (leftCount%, XMOSUE%, YMOUSE%)
DECLARE SUB MOUSERELEASERIGHT (rightCount%, XMOSUE%, YMOUSE%)
DECLARE SUB MOUSENOW (leftButton%, RIGHTBUTTON%, XMOSUE%, YMOUSE%)
CLEAR: SCREEN 8: CLS
  Mouseinstall mflag%
  ' PRINT "Setting MouseInches to 8 by 11 (8 inches of mouse motion"
  ' PRINT "across desk to move across screen, and 11 inches vertical"
  ' PRINT "mouse motion from top to bottom of screen) ..."
  MOUSERANGE 0, 0, 639, 199: MOUSEINCHES 2, 18
DIM Y(300, 90) AS INTEGER
DIM V(1800) AS INTEGER
DIM AY(3, 3) AS INTEGER
DIM HALFA(3, 3)
DIM TY(3, 1800) AS INTEGER
DIM M0U(1000) AS INTEGER
DIM KR(3, 100), ER(3, 100)
DIM XI(3, 100) AS INTEGER, X2(3, 100) AS INTEGER, X3(3, 100) AS INTEGER
DIM Y1(3, 100) AS INTEGER, Y2(3, 100) AS INTEGER, Y3(3, 100) AS INTEGER
DIM KRSM(3, 10), ERSM(3, 10), KRM(10), ERM(10)
DIM AT1AE(3, 10), AT2AE(3, 10), AT3AE(3, 10)
DIM AT1CE(3, 10), AT2CE(3, 10), AT3CE(3, 10)
DIM AT1VE(3, 10), AT2VE(3, 10), AT3VE(3, 10)
DIM AT1E(3, 10), AT2E(3, 10), AT3E(10)
DIM ATAESM(3, 10), ATACESM(3, 10), ATVESM(3, 10), ATESM(3, 10)
DIM ATAE(10), ATACEM(10), ATVEM(10), ATEM(10)
DIM RT1AE(3, 10), RT2AE(3, 10), RT3AE(3, 10)
DIM RT1CE(3, 10), RT2CE(3, 10), RT3CE(3, 10)
DIM RT1ACE(3, 10), RT2ACE(3, 10), RT3ACE(3, 10)
DIM RT1VE(3, 10), RT2VE(3, 10), RT3VE(3, 10)
DIM RT1E(3, 10), RT2E(3, 10), RT3E(3, 10)
DIM RT1AESM(3, 10), RT1CESM(3, 10), RT1VEM(3, 10), RT1ESM(3, 10)
DIM RT2AESM(3, 10), RT2CESM(3, 10), RT2VEM(3, 10), RT2ESM(3, 10)
DIM RT3AESM(3, 10), RT3CESM(3, 10), RT3VEM(3, 10), RT3ESM(3, 10)
DIM RTAESM(10), RTACEM(10), RTVEM(10), RTEM(10)
DIM OD1AE(3, 10), OD2CE(3, 10), OD3ACE(3, 10), ODVE(3, 10), ODVE(3, 10)
DIM ODAEM(10), ODCEM(10), ODAECM(10), ODVEM(10), ODTEM(10)
DIM AF1AE(3, 10), AF2AE(3, 10), AF3AE(3, 10)
DIM AF1CE(3, 10), AF2CE(3, 10), AF3CE(3, 10)
DIM AF1ACE(3, 10), AF2ACE(3, 10), AF3ACE(3, 10)
DIM AF1VE(3, 10), AF2VE(3, 10), AF3VE(3, 10)
DIM AF1E(3, 10), AF2E(3, 10), AF3E(3, 10)
DIM AFAESM(3, 10), AFACESM(3, 10), AFVESM(3, 10), AFESM(3, 10)
DIM AFAEM(10), AFACEM(10), AFVEM(10), AFEM(10)
DIM RF1AE(3, 10), RF2AE(3, 10), RF3AE(3, 10)
DIM RF1CE(3, 10), RF2CE(3, 10), RF3CE(3, 10)
DIM RF1ACE(3, 10), RF2ACE(3, 10), RF3ACE(3, 10)
DIM RF1VE(3, 10), RF2VE(3, 10), RF3VE(3, 10)
DIM RF1E(3, 10), RF2E(3, 10), RF3E(3, 10)
DIM RFAESM(3, 10), RFACESM(3, 10), RFVESM(3, 10), RFESM(3, 10)
DIM RFAEM(10), RFACEM(10), RFVEM(10), RFEM(10)
DIM OF1AE(3, 10), OF2AE(3, 10), OF3AE(3, 10)
DIM OF1CE(3, 10), OF2CE(3, 10), OF3CE(3, 10)
DIM OF1ACE(3, 10), OF2ACE(3, 10), OF3ACE(3, 10)
DIM OF1VE(3, 10), OF2VE(3, 10), OF3VE(3, 10)
DIM OF1E(3, 10), OF2E(3, 10), OF3E(3, 10)
DIM OFAESM(3, 10), OFACESM(3, 10), OFVESM(3, 10), OFESM(3, 10)
DIM OFAEM(10), OFACEM(10), OFVEM(10), OFEM(10)

************** MOUSE & TARGET IMAGE *******************************
CLS : LINE (1, 1)-(199, 1), 15 GET (1, 1)-(199, 1), MOU: CLS

************** INPUT *******************************

INPUT "NAME": N$

******** DATA FILE *******************************

OPEN N$ + ".CIG" FOR INPUT AS #1

INPUT #1, SEX, con, seq, NT

IF NT = 1 THEN TN% = 30 ELSE TN% = 90

FOR TRNO% = 1 TO TN% * 3
  FOR X% = 1 TO 90
    R = X% * (angle) * (pi)
    TY(P%: X%) = CINT(AY(P%: 0) + HALFA(P%: 1) * (HALFA(P%: 1) * COS(R)))
  NEXT X%
FOR TRNO% = 271 TO 300
  FOR X% = 1 TO 90
    R = X% * (angle) * (pi)
    TY(P%: X%) = CINT(AY(P%: 0) + HALFA(P%: 1) * (HALFA(P%: 1) * COS(R)))
  NEXT X%
FOR TRNO% = 1 TO 3
  FOR X% = 1 TO 90
    R = X% * (angle) * (pi)
    TY(P%: X%) = CINT(AY(P%: 0) + HALFA(P%: 1) * (HALFA(P%: 1) * COS(R)))
  NEXT X%

*************** SEGMENT 1 *******************************

*************** SEGMENT 2 *******************************
angle = 180 / 600
A% = AY(P%, 2) * AY(P%, 1): HALFA(P%, 2) = A% / 2
FOR X% = 1 TO 600
  R = (X% * (angle)) * (pi)
  TY(P%, X% + 400) = CINT(AY(P%, 1) + HALFA(P%, 2) - (HALFA(P%, 2) * COS(R)))
NEXT X%

*********** SEGMENT 3 ***********

angle = 180 / 200
A% = AY(P%, 3) - AY(P%, 2): HALFA(P%, 3) = A% / 2
FOR X% = 1 TO 200
  R = (X% * (angle)) * (pi)
  TY(P%, X% + 1000) = CINT(AY(P%, 2) + HALFA(P%, 3) - (HALFA(P%, 3) * COS(R)))
NEXT X%

NEXT P%

*********** ACQUISITION TRIAL ***********

IF cond <= 2 THEN GOTO BLOCK ELSE GOTO SERIAL

*********** BLOCK ***********

BLOCK:

FOR BL% = 1 TO 3
  P% = seq + BL% - 1: IF P% > 3 THEN P% = P% - 3
  FOR TR% = 1 TO TN%
    TRNO% = (BL% - 1) * TN% + TR%
    GOSUB TRIAL
  NEXT TR%
  NEXT BL%

GOTO RET

*********** SERIAL ***********

FOR TR% = 1 TO TN%
  FOR PAT% = 1 TO 3
    P% = seq + PAT% - 1: IF P% > 3 THEN P% = P% - 3
    TRNO% = TR% * 3 - 3 + PAT%
    GOSUB TRIAL
  NEXT PAT%
  NEXT TR%

*********** RETENTION TRIAL ***********

RET:

TN% = 10
IF cond MOD 2 = 1 THEN GOTO RETBLOCK ELSE GOTO RETSERIAL

*********** BLOCK ***********

RETBLOCK:

FOR BL% = 1 TO 3
  P% = seq + BL% - 1: IF P% > 3 THEN P% = P% - 3
  FOR TR% = 91 TO 100
    TRNO% = 270 + (BL% - 1) * 10 + TR% - 90
    GOSUB TRIAL
  NEXT TR%
  NEXT BL%

GOTO COFILE

*********** SERIAL ***********

RETSERIAL:

FOR TR% = 91 TO 100
  FOR PAT% = 1 TO 3
    P% = seq + PAT% - 1: IF P% > 3 THEN P% = P% - 3
    TRNO% = 270 + (TR% - 90) * 3 - 3 + PAT%
    GOSUB TRIAL
  NEXT PAT%
  NEXT TR%

NEXT TR%
GOTO COFILE

'******************************* TRIAL. *******************************

TRIAL:
CANCEL:
    DO
        MouseNow leftButton%, RIGHTBUTTON%, XMOUSE%, YMOUSE%
    LOOP UNTIL leftButton% = 0 AND RIGHTBUTTON% = 0
CLS
LOCATE 1, 1: PRINT "Trial ": TRNO%

'************ PATTERNS *************
LINE (30, 170)-(80, 170), 10
FOR X% = 1 TO 1200
    PSET (CINT(X% / 4) + 80, TY(P%, X%)), 10
NEXT X%
LINE (381, 140 - (P4b - 1) * 30)-(480, 140 - (P4b 1) * 30), 10

XX% = 0
FOR X% = 1 TO 1800 STEP 20
    XX% = XX% + 1
    PSET (CINT(X% / 4) + 30, Y(TRNO%, XX4b)), 12
NEXT X%

'************ KR (Ave. err. in mm) ****************************
KR% = 0: XX% = 0
FOR X% = 1 TO 1200 STEP 20
    XX% = XX% + 1
    DY = ABS(TY(P%, X%) - Y(TRNO%, XX%))
    KR% = KR% + DY
NEXT X%
KR(P%, TR%) = KR% / 60 * 1

'************ Ignore the trial ****************************
PRINT "Left -> go ahead"
PRINT "Right -> ignore"
    DO
        MouseNow leftButton%, RIGHTBUTTON%, XMOUSE%, YMOUSE%
    LOOP UNTIL leftButton% = -1 OR RIGHTBUTTON% = -1
    IF RIGHTBUTTON% = -1 THEN
        X1(P%, TR%) = 0: X2(P%, TR%) = 0: X3(P%, TR%) = 0: X4(P%, TR%) = 0
        Y1(P%, TR%) = 0: Y2(P%, TR%) = 0: Y3(P%, TR%) = 0: Y4(P%, TR%) = 0
        KR(P%, TR%) = 0: ER(P%, TR%) = 0: RETURN
    ELSE
        GOTO MAXMIN
    END IF

'************ MAX & MIN ****************************
MAXMIN:
    DO
        MouseNow leftButton%, RIGHTBUTTON%, XMOUSE%, YMOUSI%
    LOOP UNTIL leftButton% = 0 AND RIGHTBUTTON% = 0
MOUSERANGE 40, 0, 599, 199

'************ P1 ***********
GOSUB CPOINT
XX% = 0
    DO
        XX% = XX% + 1
    LOOP UNTIL 25 + XX% * 5 >= XMOUSE% - 40
I% = 0
    DO
        I% = I% + 1
        IF XX% + I% > 90 THEN GOTO CANCEL.
LOOP UNTIL Y(TRNO%, XX% + 1%) < Y(TRNO%, XX% + 1% + 1)
X1(P%, TR%) = (XX% + 1% + 1) * 20 - 19
Y1(P%, TR%) = Y(TRNO%, XX% + 1% + 1)
PSET (CINT(X1(P%, TR%) / 4) + 30, Y(TRNO%, XX% + 1% + 1)), 11
*********** P2 **********
GOSUB CPOINT
XX% = 0
DO
XX% = XX% + 1
LOOP UNTIL 25 + XX% * 5 >= XMOUSE% - 40
I% = 0; J% = 0
DO
I% = I% + 1
IF XX% + I% > 90 THEN GOTO CANCEL
LOOP UNTIL Y(TRNO%, XX% + I%) >= Y(TRNO%, XX% + I% + 1)
DO
J% = J% + 1
IF XX% + J% > 90 THEN GOTO CANCEL
LOOP UNTIL Y(TRNO%, XX% + J%) > Y(TRNO%, XX% + J% + 1)
K = (I% + J%) / 2
X2(P%, TR%) = (XX% + K - 1) * 20 - 19
Y2(P%, TR%) = Y(TRNO%, XX% + 1% - 1)
PSET (CINT(X2(P%, TR%) / 4) + 30, Y(TRNO%, XX% + 1% - 1)), 11
*********** P3 **********
GOSUB CPOINT
XX% = 0
DO
XX% = XX% + 1
LOOP UNTIL 25 + XX% * 5 >= XMOUSE% - 40
I% = 0; J% = 0
DO
I% = I% + 1
IF XX% + I% > 90 THEN GOTO CANCEL
LOOP UNTIL Y(TRNO%, XX% + I%) <= Y(TRNO%, XX% + I% + 1)
DO
J% = J% + 1
IF XX% + J% + 1 > 90 THEN GOTO CANCEL
LOOP UNTIL Y(TRNO%, XX% + J%) < Y(TRNO%, XX% + J% + 1)
K = (I% + J%) / 2
X3(P%, TR%) = (XX% + K - 1) * 20 - 19
Y3(P%, TR%) = Y(TRNO%, XX% + 1% - 1)
PSET (CINT(X3(P%, TR%) / 4) + 30, Y(TRNO%, XX% + 1% - 1)), 11
*********** P4 **********
GOSUB CPOINT
XX% = 0
DO
XX% = XX% + 1
LOOP WHILE 25 + XX% * 5 <= XMOUSE% + 40
IF XX% > 90 THEN XX% = 90
I% = 0
DO
I% = I% + 1
IF XX% + I% + 1 < 1 THEN GOTO CANCEL
LOOP UNTIL Y(TRNO%, XX% + 1%) > Y(TRNO%, XX% + 1% + 1)
X4(P%, TR%) = (XX% + 1% + 1) * 20 - 19
Y4(P%, TR%) = Y(TRNO%, XX% + 1% + 1)
PSET (CINT(X4(P%, TR%) / 4) + 30, Y(TRNO%, XX% + 1% + 1)), 11
LOCATE 2, 1: PRINT "Click left mouse button to the next trial"
LOCATE 3, 1: PRINT "Click right mouse button to cancel"

DO
   MouseNow leftButton%, RIGHTBUTTON%, XMUSE%, YMUSE%
   LOOP UNTIL leftButton% = -1 OR RIGHTBUTTON% = -1
   IF RIGHTBUTTON% = -1 THEN GOTO CANCEL.

************ ERR (Ave. err./Coincident/ in mm) *********************

ER% = 0, XX% = 0
FOR X% = 1 TO 1200 STEP 20
   IF (X% + (TR% + 19) / 20) + XX% - 1 = 90 THEN GOTO ERSKIP
   XX% = XX% + 1
   DY = ABS(TY(P%, X%) - Y(TRNO%, (X1(P%, TR%) + 19) / 20 + XX% - 1))
   ER% = ER% + DY
NEXT X%
ERSKIP:
   ER(P%, TR%) = ER% / XX% * 1.1
RETURN
CPOINT:
   FOR J% = 1 TO 0
      DO
         MouseNow leftButton%, RIGHTBUTTON%, XMUSE%, YMUSE%
         PUT (XMUSE% + 40, 1), MOU, XOR
         PUT (XMUSE% + 40, 1), MOU, XOR
         FOR K% = 1 TO 200: NEXT K%
         PUT (XMUSE% - 40, 1), MOU, XOR
         PUT (XMUSE% + 40, 1), MOU, XOR
      LOOP UNTIL leftButton% = J%
   NEXT J%
   BEEP
RETURN
************ COORDINATES FILE ************

COFILE:
OPEN N$ + "CDO" FOR OUTPUT AS #1
WRITE #1, SEX, cond, seq, NT
FOR P% = 1 TO 3
   FOR TR% = 1 TO 100
      WRITE #1, X1(P%, TR%), Y1(P%, TR%), X2(P%, TR%), Y2(P%, TR%), X3(P%, TR%), Y3(P%, TR%), X4(P%, TR%), Y4(P%, TR%)
   NEXT TR%
   NEXT P%
CLOSE #1
IF NT = 2 THEN GOTO ERRORS
FOR P% = 1 TO 3
   FOR TR% = 31 TO 90
      X1(P%, TR%) = 200: X2(P%, TR%) = 400: X3(P%, TR%) = 1000: X4(P%, TR%) = 1200
      Y1(P%, TR%) = 120: Y2(P%, TR%) = 90 - (P% - 1) * 30: Y3(P%, TR%) = 135 + (P% - 1) * 15:
      Y4(P%, TR%) = 120
   NEXT TR%
   NEXT P%
************ ERROR CALCULATION *********************

ERRORS:
************ KR & ERROR W/O COINCIDENT TIMING ERROR **********
$$KR = KR + KR(P\%, TR\%): ER = ER + ER(P\%, TR\%)$$

**SKIPKR:**

NEXT T%

$$KRSM(P\%, TB\%) = KR / C\%: ERSM(P\%, TB\%) = ER / C\%$$

NEXT TB%

NEXT P%

FOR TB\% = 1 TO 10

$$KR(TB\%) = (KRSM(1, TB\%) + KRSM(2, TB\%) + KRSM(3, TB\%)) / 3$$

$$ER(TB\%) = (ERSM(1, TB\%) + ERSM(2, TB\%) + ERSM(3, TB\%)) / 3$$

NEXT TB%

********************* ABSOLUTE TIMING *******************************

FOR P\% = 1 TO 3

FOR TB\% = 1 TO 10

C\% = 0

S1AE = 0; S2AE = 0; S3AE = 0; S1CE = 0; S2CE = 0; S3CE = 0

S1VE = 0; S2VE = 0; S3VE = 0; S1VE = 0; S2VE = 0; S3VE = 0

FOR TB\% = 1 TO 10

TR\% = TB\% * 10 - 10 + TR%

IF X1(P\%, TR\%) = 0 THEN GOTO SKIPAT

C\% = C\% + 1

S1AE = S1AE + ABS((X2(P\%, TR\%) - X1(P\%, TR\%)) - 400)

S2AE = S2AE + ABS((X3(P\%, TR\%) - X2(P\%, TR\%)) - 600)

S3AE = S3AE + ABS((X4(P\%, TR\%) - X3(P\%, TR\%)) - 200)

S1CE = S1CE + ((X2(P\%, TR\%) - X1(P\%, TR\%)) - 400)

S2CE = S2CE + ((X3(P\%, TR\%) - X2(P\%, TR\%)) - 600)

S3CE = S3CE + ((X4(P\%, TR\%) - X3(P\%, TR\%)) - 200)

S1VE = S1VE + (X2(P\%, TR\%) - X1(P\%, TR\%)) - (S1VE / C\%)^2

S2VE = S2VE + (X3(P\%, TR\%) - X2(P\%, TR\%)) - (S2VE / C\%)^2

S3VE = S3VE + (X4(P\%, TR\%) - X3(P\%, TR\%)) - (S3VE / C\%)^2

**SKIPAT:**

NEXT T%

FOR TB\% = 1 TO 10

TR\% = TB\% * 10 - 10 + TR%

IF X1(P\%, TR\%) = 0 THEN GOTO SKIPAT2

S1VE = S1VE + (X2(P\%, TR\%) - X1(P\%, TR\%)) - (S1VE / C\%)^2

S2VE = S2VE + (X3(P\%, TR\%) - X2(P\%, TR\%)) - (S2VE / C\%)^2

S3VE = S3VE + (X4(P\%, TR\%) - X3(P\%, TR\%)) - (S3VE / C\%)^2

**SKIPAT2:**

NEXT T%

AT1AE(P\%, TB\%) = S1AE / C\%; AT2AE(P\%, TB\%) = S2AE / C\%; AT3AE(P\%, TB\%) = S3AE / C\%

AT1CE(P\%, TB\%) = S1CE / C\%; AT2CE(P\%, TB\%) = S2CE / C\%; AT3CE(P\%, TB\%) = S3CE / C\%

AT1ACE(P\%, TB\%) = ABS(AT1CE(P\%, TB\%)); AT2ACE(P\%, TB\%) = ABS(AT2CE(P\%, TB\%));

AT3ACE(P\%, TB\%) = ABS(AT3CE(P\%, TB\%));

AT1VE(P\%, TB\%) = SQR(S1VE / C\%); AT2VE(P\%, TB\%) = SQR(S2VE / C\%); AT3VE(P\%, TB\%) = SQR(S3VE / C\%)

AT1E(P\%, TB\%) = SQR(AT1CE(P\%, TB\%)^2 + AT1VE(P\%, TB\%)^2)

AT2E(P\%, TB\%) = SQR(AT2CE(P\%, TB\%)^2 + AT2VE(P\%, TB\%)^2)

AT3E(P\%, TB\%) = SQR(AT3CE(P\%, TB\%)^2 + AT3VE(P\%, TB\%)^2)

ATAESM(P\%, TB\%) = (AT1AE(P\%, TB\%) + AT2AE(P\%, TB\%) + AT3AE(P\%, TB\%)) / 3

ATACESM(P\%, TB\%) = (AT1ACE(P\%, TB\%) + AT2ACE(P\%, TB\%) + AT3ACE(P\%, TB\%)) / 3

ATVESM(P\%, TB\%) = (AT1VE(P\%, TB\%) + AT2VE(P\%, TB\%) + AT3VE(P\%, TB\%)) / 3

ATVESM(P\%, TB\%) = (AT1E(P\%, TB\%) + AT2E(P\%, TB\%) + AT3E(P\%, TB\%)) / 3

NEXT TB%

NEXT P%

FOR TB\% = 1 TO 10

ATAEM(TB\%) = (ATAESM(1, TB\%) + ATAESM(2, TB\%) + ATAESM(3, TB\%)) / 3

ATACESM(TB\%) = (ATACESM(1, TB\%) + ATACESM(2, TB\%) + ATACESM(3, TB\%)) / 3

ATVESM(TB\%) = (ATVESM(1, TB\%) + ATVESM(2, TB\%) + ATVESM(3, TB\%)) / 3
ATEM(TB%) = (ATESM(1, TB%) + ATESM(2, TB%) + ATESM(3, TB%)) / 3

NEXT TB%

*************** RELATIVE TIMING ***********************

FOR P% = 1 TO 3
FOR TB% = 1 TO 10

C% = 0
S1AE = 0: S2AE = 0: S3AE = 0: S1CE = 0: S2CE = 0: S3CE = 0
S1VE = 0: S2VE = 0: S3VE = 0

FOR T% = 1 TO 10
TR% = TB% * 10 - 10 + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPRT
C% = C% + 1
TT% = X4(P%, TR%) - X1(P%, TR%) / TT% * 100 - S3VEM / C%)

_SKIPRT:

NEXT T%

FOR TB% = 1 TO 10

TR% = TB% * 10 - 10 + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPRT2

_SKIPRT2:

NEXT T%

RT1AE(P%, TB%) = S1AE / C%: RT2AE(P%, TB%) = S2AE / C%: RT3AE(P%, TB%) = S3AE / C%
RT1CE(P%, TB%) = S1CE / C%: RT2CE(P%, TB%) = S2CE / C%: RT3CE(P%, TB%) = S3CE / C%
RT1ACE(P%, TB%) = T/2CE(P%, TB%)) / RT2ACE(P%, TB%) = T/2CE(P%, TB%)) / RT3ACE(P%, TB%) = T/2CE(P%, TB%))

RT1VE(P%, TB%) = SQR(S1VE / C%): RT2VE(P%, TB%) = SQR(S2VE / C%): RT3VE(P%, TB%) = SQR(S3VE / C%)

RT1E(P%, TB%) = SQR(RT1CE(P%, TB%)) / 2 + RT1VE(P%, TB%)) / 2
RT2E(P%, TB%) = SQR(RT2CE(P%, TB%)) / 2 + RT2VE(P%, TB%)) / 2
RT3E(P%, TB%) = SQR(RT3CE(P%, TB%)) / 2 + RT3VE(P%, TB%)) / 2

RTAESM(P%, TB%) = (RT1AE(P%, TB%) + RT2AE(P%, TB%) + RT3AE(P%, TB%)) / 3
RTACESM(P%, TB%) = (RT1ACE(P%, TB%) + RT2ACE(P%, TB%) + RT3ACE(P%, TB%)) / 3
RTAVESM(P%, TB%) = (RT1VE(P%, TB%) + RT2VE(P%, TB%) + RT3VE(P%, TB%)) / 3

RTEMS(P%, TB%) = (RT1E(P%, TB%) + RT2E(P%, TB%) + RT3E(P%, TB%)) / 3

NEXT TB%

FOR P% = 1 TO 3
FOR TB% = 1 TO 10

C% = 0

*************** OVERALL DURATION ***********************

FOR P% = 1 TO 3
FOR TB% = 1 TO 10

C% = 0
AE = 0; CE = 0; VEM = 0; VE = 0
FOR T% = 1 TO 10
TR% = TB% * 10 - 10 + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPOD
C% = C% + 1
AE = AE + ABS((X4(P%, TR%) - X1(P%, TR%)) - 1200)
CE = CE + ((X4(P%, TR%) - X1(P%, TR%)) - 1200)
VEM = VEM + (X4(P%, TR%) - X1(P%, TR%))
VE = (X4(P%, TR%) - X1(P%, TR%)) - (VEM / C%)^2
NEXT T%
NEXT TR%
NEXT TB%
NEXT P%

 mạch AE = AE + ABS((X4(P%, TR%) - X1(P%, TR%)) - 1200)
 mạch CE = CE + ((X4(P%, TR%) - X1(P%, TR%)) - 1200)
 mạch VEM = VEM + (X4(P%, TR%) - X1(P%, TR%))
 mạch VE = (X4(P%, TR%) - X1(P%, TR%)) - (VEM / C%)^2

SKIPOD:
NEXT T%
FOR T% = 1 TO 10
TR% = TB% * 10 - 10 + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPOD2
C% = C% + 1
S1AE = S1AE + ABS(ABS(Y2(P%, TR%) - Y1(P%, TR%)) * 1.1 / ((X2(P%, TR%) - X1(P%, TR%)) / 1000) - 123.75 * P%)
S2AE = S2AE + ABS(ABS(Y3(P%, TR%) - Y2(P%, TR%)) * 1.1 / ((X3(P%, TR%) - X2(P%, TR%)) / 1000) - 55 * P%)
S3AE = S3AE + ABS(ABS(Y4(P%, TR%) - Y3(P%, TR%)) * 1.1 / ((X4(P%, TR%) - X3(P%, TR%)) / 1000) - 82.5 * P%)
S1CE = S1CE + (ABS(Y2(P%, TR%) - Y1(P%, TR%)) * 1.1 / ((X2(P%, TR%) - X1(P%, TR%)) / 1000) - 123.75 * P%)
S2CE = S2CE + (ABS(Y3(P%, TR%) - Y2(P%, TR%)) * 1.1 / ((X3(P%, TR%) - X2(P%, TR%)) / 1000) - 55 * P%)
S3CE = S3CE + (ABS(Y4(P%, TR%) - Y3(P%, TR%)) * 1.1 / ((X4(P%, TR%) - X3(P%, TR%)) / 1000) - 82.5 * P%)
S1VEM = S1VEM + ABS(Y2(P%, TR%) - Y1(P%, TR%)) * 1.1 / ((X2(P%, TR%) - X1(P%, TR%)) / 1000)
S2VEM = S2VEM + ABS(Y3(P%, TR%) - Y2(P%, TR%)) * 1.1 / ((X3(P%, TR%) - X2(P%, TR%)) / 1000)
S3VEM = S3VEM + ABS(Y4(P%, TR%) - Y3(P%, TR%)) * 1.1 / ((X4(P%, TR%) - X3(P%, TR%)) / 1000)

Skipaf:
NEXT T%
FOR T% = 1 TO 10
TR% = TB% * 10 - 10 + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPAF2
S1VE = S1VE + (ABS(Y2(P%, TR%) - Y1(P%, TR%)) * 1.1 / ((X2(P%, TR%) - X1(P%, TR%)) / 1000) * (S1VEM / C%)^2
S2VE = S2VE + (ABS(Y3(P%, TR%) - Y2(P%, TR%)) * 1.1 / ((X3(P%, TR%) - X2(P%, TR%)) / 1000) * (S2VEM / C%)^2
S3VE = S3VE + (ABS(Y4(P%, TR%) - Y3(P%, TR%)) * 1.1 / ((X4(P%, TR%) - X3(P%, TR%)) / 1000) * (S3VEM / C%)^2
SKIPAF2:
NEXT T%
AF1AE(P%, TB%) = S1AE / C%: AF2AE(P%, TB%) = S2AE / C%: AF3AE(P%, TB%) = S3AE / C%
AF1CE(P%, TB%) = S1CE / C%: AF2CE(P%, TB%) = S2CE / C%: AF3CE(P%, TB%) = S3CE / C%
AF1ACE(P%, TB%) = ABS(AF1CE(P%, TB%)): AF2ACE(P%, TB%) = ABS(AF2CE(P%, TB%))
AF3ACE(P%, TB%) = ABS(AF3CE(P%, TB%))
AF1VE(P%, TB%) = SQR(S1VE / C%): AF2VE(P%, TB%) = SQR(S2VE / C%): AF3VE(P%, TB%) = SQR(S3VE / C%)
AF1E(P%, TB%) = SQR(AF1CE(P%, TB%)^2 + AF1VE(P%, TB%)^2)
AF2E(P%, TB%) = SQR(AF2CE(P%, TB%)^2 + AF2VE(P%, TB%)^2)
AF3E(P%, TB%) = SQR(AF3CE(P%, TB%)^2 + AF3VE(P%, TB%)^2)
AF1AESM(P%, TB%) = (AF1AE(P%, TB%) + AF2AE(P%, TB%) + AF3AE(P%, TB%)) / 3
AFACESM(P%, TB%) = (AF1ACE(P%, TB%) + AF2ACE(P%, TB%) + AF3ACE(P%, TB%)) / 3
AFVESM(P%, TB%) = (AF1VE(P%, TB%) + AF2VE(P%, TB%) + AF3VE(P%, TB%)) / 3
NEXT TB%
NEXT P%
FOR TB% = 1 TO 10
AF1AESM(TB%) = (AF1AESM(1, TB%) + AF1AESM(2, TB%) + AF1AESM(3, TB%)) / 3
AFACESM(TB%) = (AFACESM(1, TB%) + AFACESM(2, TB%) + AFACESM(3, TB%)) / 3
AFVESM(TB%) = (AFVESM(1, TB%) + AFVESM(2, TB%) + AFVESM(3, TB%)) / 3
NEXT TB%
*------------------------------------------------ RELATIVE FORCE *------------------------------------------------
FOR P% = 1 TO 3
FOR TB% = 1 TO 10
C% = 0
S1AE = 0: S2AE = 0: S3AE = 0: S1CE = 0: S2CE = 0: S3CE = 0
S1VE = 0: S2VE = 0: S3VE = 0: S1VE = 0: S2VE = 0: S3VE = 0
FOR T% = 1 TO 10
TR% = TB% * 10 - 10 + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPRF
C% = C% + 1
SL1 = ABS(Y2(P%, TR%) - Y1(P%, TR%)) * 1.1 / ((X2(P%, TR%) - X1(P%, TR%)) / 1000)
SL2 = ABS(Y3(P%, TR%) - Y2(P%, TR%)) * 1.1 / ((X3(P%, TR%) - X2(P%, TR%)) / 1000)
SL3 = ABS(Y4(P%, TR%) - Y3(P%, TR%)) * 1.1 / ((X4(P%, TR%) - X3(P%, TR%)) / 1000)
TT = SL1 + SL2 + SL3
S1AE = S1AE + ABS(SL1 / TT * 100 - 47.36842)
S2AE = S2AE + ABS(SL2 / TT * 100 - 21.05263)
S3AE = S3AE + ABS(SL3 / TT * 100 - 31.57895)
S1CE = S1CE + (SL1 / TT * 100 - 47.36842)
S2CE = S2CE + (SL2 / TT * 100 - 21.05263)
S3CE = S3CE + (SL3 / TT * 100 - 31.57895)
S1VE = S1VE + SL1 / TT * 100
S2VE = S2VE + SL2 / TT * 100
S3VE = S3VE + SL3 / TT * 100
SKIPRF:
NEXT T%
FOR TP = 1 TO 10
    TRB = TB% * 10 - 10 + TP
    IF XI(P%, TR%) = 0 THEN GOTO SKIPRF2
    SL1 = ABS(Y2(P%, TR%) - Y1(P%, TR%)) * 1.1 / ((X2(P%, TR%) - X1(P%, TR%)) / 1000)
    SL2 = ABS(Y3(P%, TR%) - Y2(P%, TR%)) * 1.1 / ((X3(P%, TR%) - X2(P%, TR%)) / 1000)
    SL3 = ABS(Y4(P%, TR%) - Y3(P%, TR%)) * 1.1 / ((X4(P%, TR%) - X3(P%, TR%)) / 1000)
    TT = SL1 + SL2 + SL3
    S1VE = S1VE + (SL1 / TT * 100 - (S1VE / C%)) * 2
    S2VE = S2VE + (SL2 / TT * 100 - (S2VE / C%)) * 2
    S3VE = S3VE + (SL3 / TT * 100 - (S3VE / C%)) * 2
    SKIPRF2:
    NEXT TP
    RF1AE(P%, TB%) = S1AE / C%: RF2AE(P%, TB%) = S2AE / C%: RF3AE(P%, TB%) = S3AE / C%
    RF1CE(P%, TB%) = S1CE / C%: RF2CE(P%, TB%) = S2CE / C%: RF3CE(P%, TB%) = S3CE / C%
    RF1ACE(P%, TB%) = ABS(RF1CE(P%, TB%): RF2ACE(P%, TB%) = ABS(RF2CE(P%, TB%)):
    RF3ACE(P%, TB%) = ABS(RF3CE(P%, TB%))
    RF1VE(P%, TB%) = SQR(S1VE / C%): RF2VE(P%, TB%) = SQR(S2VE / C%): RF3VE(P%, TB%) =
    SQR(S3VE / C%)
    RFAEM(TB%) = (RFAESM(1, TB%) + RFAESM(2, TB%) + RFAESM(3, TB%)) / 3
    RFACEM(TB%) = (RFACESM(1, TB%) + RFACESM(2, TB%) + RFACESM(3, TB%)) / 3
    RFWEM(TB%) = (RFVESM(1, TB%) + RFVESM(2, TB%) + RFVESM(3, TB%)) / 3
    RFEM(TB%) = (RFESM(1, TB%) + RFESM(2, TB%) + RFESM(3, TB%)) / 3
    NEXT TB%
FOR PB = 1 TO 3
    FOR TP = 1 TO 10
        TRB = TB% * 10 - 10 + TP
        IF XI(P%, TR%) = 0 THEN GOTO SKIPOF
        C% = C% + 1
        SL1 = ABS(Y2(P%, TR%) - Y1(P%, TR%)) * 1.1 / ((X2(P%, TR%) - X1(P%, TR%)) / 1000)
        SL2 = ABS(Y3(P%, TR%) - Y2(P%, TR%)) * 1.1 / ((X3(P%, TR%) - X2(P%, TR%)) / 1000)
        SL3 = ABS(Y4(P%, TR%) - Y3(P%, TR%)) * 1.1 / ((X4(P%, TR%) - X3(P%, TR%)) / 1000)
        AE = AE + ABS((SL1 + SL2 + SL3) - (123.75 + 55 + 82.5) * P%)
        CE = CE + ((SL1 + SL2 + SL3) - (123.75 + 55 + 82.5) * P%)
        VEM = VEM + (SL1 + SL2 + SL3)
        SKIPF:
        NEXT TP
    FOR TB = 1 TO 10
        TRB = TB% * 10 - 10 + TP
        IF XI(P%, TR%) = 0 THEN GOTO SKIPF2
        SL1 = ABS(Y2(P%, TR%) - Y1(P%, TR%)) * 1.1 / ((X2(P%, TR%) - X1(P%, TR%)) / 1000)
        SL2 = ABS(Y3(P%, TR%) - Y2(P%, TR%)) * 1.1 / ((X3(P%, TR%) - X2(P%, TR%)) / 1000)
        SL3 = ABS(Y4(P%, TR%) - Y3(P%, TR%)) * 1.1 / ((X4(P%, TR%) - X3(P%, TR%)) / 1000)
        VE = VE + (SL1 + SL2 + SL3) - (VEM / C%) * 2
        SKIPF2:
NEXT TB%
OFAE(P%, TB%) = AE / C%
OPCE(P%, TB%) = CE / C%
OFACE(P%, TB%) = ABS(OPCE(P%, TB%))
OFVE(P%, TB%) = SQR(VE / C%)
OFE(P%, TB%) = SQR(OPCE(P%, TB%) ^ 2 + OFVE(P%, TB%) ^ 2)
NEXT TB%
NEXT P%
FOR TB% = 1 TO 10
OFAEM(TB%) = (OFAE(1, TB%) + OFAE(2, TB%) + OFAE(3, TB%)) / 3
OFACEM(TB%) = (OFACE(1, TB%) + OFACE(2, TB%) + OFACE(3, TB%)) / 3
OFVEM(TB%) = (OFVE(1, TB%) + OFVE(2, TB%) + OFVE(3, TB%)) / 3
OFEEM(TB%) = (OFE(1, TB%) + OFE(2, TB%) + OFE(3, TB%)) / 3
NEXT TB%
GOTO JUMP

*************** PRINT OUT *****************************

GOSUB TITLE
LPRINT ******************** AE: (Absolute timing) ********************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "#######", TB%; AT1AE(P%, TB%); AT2AE(P%, TB%); AT3AE(P%, TB%); ATAEEM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT: NEXT K%
GOSUB TITLE
LPRINT ******************** CE (Absolute timing) ********************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3"
FOR TB% = 1 TO 10
LPRINT USING "#######", TB%; AT1CE(P%, TB%); AT2CE(P%, TB%); AT3CE(P%, TB%); ATCEEM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT: NEXT K%
GOSUB TITLE
LPRINT ******************** ACE (Absolute timing) ********************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "####
  

TB%: AT1VE(P%, TB%); AT2VE(P%, TB%); AT3VE(P%, TB%); AT4VE(P%, TB%); AT5VE(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "************** VE (Absolute timing) **************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "####
  

TB%: AT1VE(P%, TB%); AT2VE(P%, TB%); AT3VE(P%, TB%); AT4VE(P%, TB%); AT5VE(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "************** AE (Relative timing) **************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "#####", TB%; RT1AE(P%, TB%); RT2AE(P%, TB%); RT3AE(P%, TB%);
RTACESM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "*************** CE (Relative timing) ******************* *"
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3"
FOR TB% = 1 TO 10
LPRINT USING "#####", TB%; RT1CE(P%, TB%); RT2CE(P%, TB%); RT3CE(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "*************** ACE (Relative timing) ******************* *"
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "#####", TB%; RT1ACE(P%, TB%); RT2ACE(P%, TB%); RT3ACE(P%,
TB%); RTACESM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "*************** VE (Relative timing) *************** *
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
  LPRINT "Task C (Large amplitude)"
ENDIF
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
  LPRINT USING "###### ", TB%; RT1VE(P%, TB%); RT2VE(P%, TB%); RT3VE(P%, TB%);
  RTVESM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "**********••••*** E (Relative timing) ***************
FOR P% = 1 TO 3
  LPRINT IF  P%  = 1 THEN
    LPRINT Task A (Small amplitude)*
  ELSEIF IT  = 2 THEN
    LPRINT Task B (Medium amplitude)*
  ELSE
    LPRINT Task C (Large amplitude)*
  END IF
  LPRINT Trial Block*. "Segment 1", "Segment 2", "Segment 3", "Mean"
  LPRINT USING "##### ## " ; TB%; RT1VE(P% , TB% ); RT2VE(P% , TB% ); RT3VE(P% , TB% );
  RTVESM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "**********•••• (Overall duration) ***************
FOR P% = 1 TO 3
  LPRINT IF  P%  = 1 THEN
    LPRINT Task A (Small amplitude)*
  ELSEIF IT  = 2 THEN
    LPRINT Task B (Medium amplitude)*
  ELSE
    LPRINT Task C (Large amplitude)*
  END IF
  LPRINT Trial Block", " AE", " CE(ACE)", " VE", " E"
  FOR TB% = 1 TO 10
    LPRINT USING "####### ", TB%; ODAE(P%, TB%); ODCE(P%, TB%); ODVE(P%, TB%);
    ODE(P%, TB%)
  NEXT TB%
  NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "************** AE (Absolute force) ***************
FOR P% = 1 TO 3
  LPRINT IF  P%  = 1 THEN
    LPRINT Task A (Small amplitude)*
  ELSEIF IT  = 2 THEN
    LPRINT Task B (Medium amplitude)*
  ELSE
  END IF
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "###.## TB%; AF1ACE(P%, TB%); AF2ACE(P%, TB%); AF3ACE(P%, TB%); AFACESM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT: NEXT K%
GOSUB TITLE
LPRINT "*************** CE (Absolute force) ***************"
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3"
FOR TB% = 1 TO 10
LPRINT USING "###.## TB%; AF1ACE(P%, TB%); AF2ACE(P%, TB%); AF3ACE(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "*************** ACF (Absolute force) ***************"
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "###.## TB%; AF1ACE(P%, TB%); AF2ACE(P%, TB%); AF3ACE(P%, TB%); AFACESM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "*************** VE (Absolute force) ***************"
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "#####      "; TB%; AF1VE(P%, TB%); AF2VE(P%, TB%); AF3VE(P%, TB%); AFVSM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "*************** AE (Relative force) *************** "
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "#####      "; TB%; AF1AF(P%, TB%); AF2AF(P%, TB%); AF3AF(P%, TB%); AFVAF(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "*************** CE (Relative force) *************** ",
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3"
FOR TB% = 1 TO 10
LPRINT USING "##### " ; TB%; RF1ACE(P%, TB%); RF2ACE(P%, TB%); RF3ACE(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "****************** ACE (Relative force) ******************  
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "####" ; TB%; RF1ACE(P%, TB%); RF2ACE(P%, TB%); RF3ACE(P%, TB%);
RFACESM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "*************** VE (Relative force) ***************  
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "##### " ; TB%; RF1VE(P%, TB%); RF2VE(P%, TB%); RF3VE(P%, TB%);
RFVESM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
GOSUB TITLE
LPRINT "*************** F (Relative force) ***************  
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Large amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 10
LPRINT USING "####*", TB%; RF1E(P%, TB%); RF2E(P%, TB%); RF3E(P%, TB%);
RFESM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
OOSUB TITLE
LPRINT "*************** (Overall force) **********************
FOR P% = 1 TO 3
LPRINT IF P% = 1 THEN LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN LPRINT "Task B (Medium amplitude)"
ELSE LPRINT "Task C (Large amplitude)"
END IF
LPRINT LPRINT "Trial block", *", AE", *", CE(ACE)", *", VE", *", E"
FOR TB% = 1 TO 10
LPRINT USING "####*", TB%; OFAE(P%, TB%); OFCE(P%, TB%); OFVE(P%, TB%); OFE(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
OOSUB TITLE
LPRINT "*************** KR & ERROR W/O COINCIDNET TIMING ERROR **********************
FOR P% = 1 TO 3
LPRINT IF P% = 1 THEN LPRINT "Task A (Small amplitude)"
ELSEIF P% = 2 THEN LPRINT "Task B (Medium amplitude)"
ELSE LPRINT "Task C (Large amplitude)"
END IF
IF NT = 2 THEN GOTO POKRER
FOR P% = 1 TO 3
FOR TB% = 4 TO 9
KRSM(P%, TB%) = 0: ERSM(P%, TB%) = 0
NEXT TB%
NEXT P%
POKRER:
LPRINT LPRINT "Trial block", *", KR", *", ERROR"
FOR TB% = 1 TO 10
LPRINT USING "####*", TB%; KRSM(P%, TB%); ERSM(P%, TB%)
NEXT TB%
NEXT P%
FOR K% = 1 TO 16: LPRINT : NEXT K%
JUMP:
OOSUB TITLE
LPRINT "****** MEAN (Timing)
LPRINT "************* Absolute timing performance (ms)"
LPRINT "Trial block", *", AE", *", ACE", *", VE", *", E"
FOR TB% = 1 TO 10
LPRINT USING "****  ****  ****  ****","TB%","ATAEM(TB%),","ATACEM(TB%),","ATVEM(TB%),","ATEM(TB%)"
NEXT TB%
LPRINT
LPRINT "Relative timing performance (%)
LPRINT "Trial block"," AE"," ACE"," VE"," E 
FOR TB% = 1 TO 10
LPRINT USING "****  ****  ****  ****"," TB%"," RTAEM(TB%),"," RTACEM(TB%),"," RTVEM(TB%),"," RTEM(TB%)"
NEXT TB%
LPRINT
LPRINT "Overall duration performance (ms)
LPRINT "Trial block"," AE"," ACE"," VE"," E 
FOR TB% = 1 TO 10
LPRINT USING "****  ****  ****  ****"," TB%"," ODAEM(TB%),"," ODACEM(TB%),"," ODVEM(TB%),"," ODEM(TB%)"
NEXT TB%
FOR K% = 1 TO 15: LPRINT : NEXT K%
GOSUB TITLE
LPRINT " MEAN (Force) 
LPRINT "Absolute force performance (mm/s)
LPRINT "Trial block"," AE"," ACE"," VE 
FOR TB% = 1 TO 10
LPRINT USING "****  ****  ****  ****"," TB%"," AFAEM(TB%),"," AFACEM(TB%),"," AFVEM(TB%),"," AFEM(TB%)"
NEXT TB%
LPRINT
LPRINT "Relative force performance (%)
LPRINT "Trial block"," AE"," ACE"," VE 
FOR TB% = 1 TO 10
LPRINT USING "****  ****  ****  ****"," TB%"," RF-AEM(TB%),"," RFACEM(TB%),"," RFVEM(TB%),"," RFEM(TB%)"
NEXT TB%
LPRINT
LPRINT "Overall force performance (mm/s)
LPRINT "Trial block"," AE"," ACE"," VE 
FOR TB% = 1 TO 10
LPRINT USING "****  ****  ****  ****"," TB%"," OFAEM(TB%),"," OFACEM(TB%),"," OFVEM(TB%),"," OFEM(TB%)"
NEXT TB%
FOR K% = 1 TO 15: LPRINT : NEXT K%
GOSUB TITLE
LPRINT " Mean (KR & ER) "
IF NT = 2 THEN GOTO POKRER2
FOR P% = 1 TO 3
FOR TB% = 4 TO 9
KRM(TB%) = 0: ERM(TB%) = 0
NEXT TB%
NEXT P%
POKRER2:
LPRINT
LPRINT "Trial block"," KR (mm)","ERROR (mm)
FOR TB% = 1 TO 10
LPRINT USING "****  ****"," TB%"," KRM(TB%),"," ERM(TB%)"
NEXT TB%
END
******** PRINT OUT NAME & CONDITION ********

TITLE:
LPRINT "CI EXPERIMENT W/ MOUSE (AMPLITUDE MODIFICATIONS OF THE SAME GMP)"
LPRINT "Subject: *, N$
IF SEX = 1 THEN
  LPRINT "Male"
ELSE
  LPRINT "Female"
ENDIF
IF cond = 1 THEN
  LPRINT "Condition: BB"
ELSEIF cond = 2 THEN
  LPRINT "Condition: BS"
ELSEIF cond = 3 THEN
  LPRINT "Condition: SB"
ELSE
  LPRINT "Condition: SS"
ENDIF
IF seq = 1 THEN
  LPRINT "Task order: ABC"
ELSEIF seq = 2 THEN
  LPRINT "Task order: BCA"
ELSE
  LPRINT "Task order: CAB"
ENDIF
LPRINT RETURN
APPENDIX M: COMPUTER PROGRAMS FOR CHAPTER 4 EXPERIMENT 4

-------------------- Contextual Interference Experiment 4 ---------------------

-------------------- Data Acquisition Program for Session 1 --------------------

-------------------- Programmed by Hiroshi Sekiya --------------------

DEQUEUE SUB ABORT ()
DEQUEUE SUB BASDASG (MD%, BY VAL dummy%, FLAG%)
DEQUEUE SUB INITDASG ()
DEQUEUE SUB TRIAL ()
DEQUEUE SUB FILTER ()
DEQUEUE SUB INITIATION ()

REM ........................................................................
REM Initialize variables
REM ........................................................................
DIM D% (16)  ' DASG PARMS
DIM DATAPT% (600)  ' Data points collected by DASG
DIM CHANNEL% (1000)  ' Channels from which data points were collected
DIM DASGERR$ (28)  ' DASG error messages
DIM SHARED AY(3) AS INTEGER
DIM SHARED TY(3,600)
DIM SHARED TAR(900) AS INTEGER, ARM(900) AS INTEGER
DIM SHARED ORG(600), FILT(600), TEMP(600), X(600)
DIM SHARED ORG(), FILT(), TEMP(), X()
DIM SHARED ORGY(), FILT(), Y()
COMMON SHARED D%, DATAPT %, CHANNEL %, DASGERR$
COMMON SHARED MD%, FLAG%
COMMON SHARED NBRSAMP%, NBRTRIAL%, TCOUNTER%, FILENAME$
COMMON SHARED C%, BC%
CLEAR : KEY OFF
MD% = 0
FLAG% = 0
NBRTRIAL% = 10
NBRSAMP% = 600

REM ........................................................................
REM Initialize error messages
REM ........................................................................
OPEN "C:\windy\programs\dsgerr.data" FOR INPUT AS #1
FOR I% = 0 TO 28
  INPUT #1, DASGERR$(I%)
NEXT I%
CLOSE #1

REM ........................................................................
REM Initialize the uCDAS-16G board for data collection
REM ........................................................................
CALL INITDASG

CALL INITIATION

SCREEN 12: WINDOW (-9.25)<(630, 40): CLS
CIRCLE (0, 0), 5, 10: GET (-5, 1)<(-5, 1), TAR: CLS
LINE (-5, 0)<(5, 0), 12
LINE (0, -1)<(0, 1), 12: ' LINE (-1, 1)<(-1, 1), 12: LINE (1, -1)<(1, 1), 12
GET (-5, 1)<(-5, 1), ARM: CLS
REM ........................................................................
REM ........................................................................
REM ........................................................................
hiro:
PRINT "Locate the arm at position 1 then press any key to continue..." DO LOOP WHILE INKEY$ = " " MD% = 3: FLAG% = 0: D%(0) = 0 CALL BASDASQ(MD%, VARPTR(D%(0)), FLAG%) POS1% = D%(0); PRINT D%(0) IF FLAG% <> 0 THEN CALL ABORT PRINT "Locate the arm at position 2 then press any key to continue..." DO LOOP WHILE INKEY$ = " " MD% = 3: FLAG% = 0: D%(0) = 0 CALL BASDASQ(MD%, VARPTR(D%(0)), FLAG%) POS2% = D%(0); PRINT D%(0) IF FLAG% <> 0 THEN CALL ABORT RANGE% = ABS(POS2% - POS1%): PRINT "RANGE = ", RANGE% ADUNIT = .9 / RANGE% GOTO hiro PRINT "Press any key to continue..." DO LOOP WHILE INKEY$ = " " REM Prompt for subject's record REM .... Print subject's record SCREEN 2 INPUT "NAME", NS PRINT PRINT "SESSION" PRINT " Acquisition --> 1" INPUT " Retention --> 2", SESSION%: PRINT IF SESSION% = 2 THEN GOTO DREAD PRINT "SEX" PRINT " Male --> 1" INPUT " Female --> 2", SEX%: PRINT INPUT "AGE", AGE%: PRINT PRINT "CONDITION" PRINT " B-B --> 1" PRINT " B-S --> 2" PRINT " S-B --> 3" INPUT " S-S --> 4", COND%: PRINT PRINT "SEQUENCE" PRINT " ABC --> 1" PRINT " BCA --> 2" INPUT " CAB --> 3", SEQ%: PRINT CLS GOTO SINWAVE DREAD: OPEN "A:\" + NS + " SEI" FOR INPUT AS #1 INPUT #1, SEX%, AGE%, COND%, SEQ% CLOSE #1 CLS ********** SINE WAVE ********** SINWAVE: SCREEN 12: WINDOW (-9,-25)-(630,40) ********* Y COORDINATES ********* AY(1,1) = 0: AY(1,2) = 30: AY(1,3) = -15: AY(1,4) = 0 AY(2,1) = 0: AY(2,2) = 20: AY(2,3) = -10: AY(2,4) = 0 AY(3,1) = 0: AY(3,2) = 10: AY(3,3) = -5: AY(3,4) = 0 ********* GOAL PATTERNS ********* Pi = 3.141592653589# FOR P% = 1 TO 3
FP% = 60

******************************************************** SEGMENT 1
********************************************************

ANGLE = 180 / (24 + P% * 12)
HALFA = (AY(P%, 2) - AY(P%, 1)) / 2
FOR X% = 1 TO 24 + P% * 12
TY(P%, X% + FP%) = AY(P%, 1) + HALFA - HALFA * COS(X% * ANGLE * PI / 80)
NEXT X%

******************************************************** SEGMENT 2
********************************************************

ANGLE = 180 / (60 + P% * 30)
HALFA = (AY(P%, 3) - AY(P%, 2)) / 2
FOR X% = 1 TO 60 + P% * 30
TY(P%, X% + 24 + P% * 12 + FP%) = AY(P%, 2) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%

******************************************************** SEGMENT 3
********************************************************

ANGLE = 180 / (40 + P% * 20)
HALFA = (AY(P%, 4) - AY(P%, 3)) / 2
FOR X% = 1 TO 40 + P% * 20
TY(P%, X% + 84 + P% * 42 + FP%) = AY(P%, 3) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%

FOR X% = 1 TO 600
PSET (X%, TY(P%, X%)), 10
NEXT X%

GOTO TRNCOD
END

CLS

IF SESSION% = 2 THEN GOTO NOPRACTICE

******************************************************** PRACTICE TRIALS
********************************************************

FOR I = 1 TO 6
TRNO% = 0; P% = 2
GOSUB TRIALLOOP
NEXT I

******************************************************** DATA FILE
********************************************************

OPEN "A:" + N$ + "SE1" FOR OUTPUT AS #1
WRITE #1, SEX', A, FA', COND', SEQ'
CLOSE #1

NOPRACTICE:
IF SESSION% = 1 THEN TN% = 20 ELSE TN% = 5
IF SESSION% = 1 AND COND% <= 2 THEN
GOTO BLOCK
ELSEIF SESSION% = 1 AND COND% > 2 THEN
GOTO SERIAL
ELSEIF SESSION% = 2 AND COND% MOD 2 = 0 THEN
GOTO RBLOCK
ELSEIF SESSION% = 2 AND COND% MOD 2 <> 0 THEN
GOTO RSERIAL
ELSE
PRINT "ERROR"
END IF

******************************************************** BLOCK
********************************************************

BLOCK
FOR BL% = 1 TO 3
P% = SEQ% + BL% - 1: IF P% > 3 THEN P% = P% - 3
FOR TR% = 1 TO TN%
TRNO% = (BL% - 1) * TN% + TR%
GOSUB TRIALLOOP
IF TRNO% MOD 20 = 0 AND TRNO% < TN% * 3 THEN GOSUB BREAK
NEXT TR%

FOR X% = 1 TO 6
TRNO% = 0; P% = 2
GOSUB TRIALLOOP
NEXT X%

GOTO TRNCOD
END
NEXT BL%
GOTO THANKS

**************** SERIAL ****************

SERIAL:
FOR TR% = 1 TO TN%
FOR PAT% = 1 TO 3
P% = SEQ% + PAT% - 1: IF P% > 3 THEN P% = P% - 3
TRNO% = TR% * 3 - 3 + PAT%
GOSUB TRIALLOOP
    IF TRNO% MOD 20 = 0 AND TRNO% < TN% * 3 THEN GOSUB BREAK
NEXT PAT%
NEXT TR%
GOTO THANKS

**************** RET/TRN BLOCK ****************

RBLOCK:
'******** BLOCKED RETENTION TRIALS ********
FOR BL% = 1 TO 3
P% = SEQ% + BL% - 1: IF P% > 3 THEN P% = P% - 3
FOR TR% = 1 TO TN%
    TRNO% = (BL% - 1) * TN% + TR%
    GOSUB TRIALLOOP
NEXT TR%
NEXT BL%

******** BLOCKED TRANSFER TRIALS ********
LOCATE 10, 5: PRINT "The next 15 trials will have slightly different patterns."
TRNT = TIMER
DO: LOOP UNTIL TIMER - TRNT > 5: CLS
GOSUB TRNCOD
FOR BL% = 1 TO 3
    P% = SEQ% + BL% - 1: IF P% > 3 THEN P% = P% - 3
    FOR TR% = 1 TO TN%
        TRNO% = (BL% - 1) * TN% + TR%
        GOSUB TRIALLOOP
    NEXT TR%
NEXT BL%
GOTO THANKS

**************** SERIAL SERIAL ****************

RSERIAL:
'******** SERIAL RETENTION TRIALS ********
FOR TR% = 1 TO TN%
FOR PAT% = 1 TO 3
P% = SEQ% + PAT% - 1: IF P% > 3 THEN P% = P% - 3
TRNO% = TR% * 3 - 3 + PAT%
GOSUB TRIALLOOP
NEXT PAT%
NEXT TR%

******** SERIAL TRANSFER TRIALS ********
LOCATE 10, 5: PRINT "The next 15 trials will have slightly different patterns."
TRNT = TIMER
DO: LOOP UNTIL TIMER - TRNT > 5: CLS
GOSUB TRNCOD
FOR TR% = 1 TO TN%
FOR PAT% = 1 TO 3
    P% = SEQ% + PAT% - 1: IF P% > 3 THEN P% = P% - 3
    TRNO% = TN% * 3 + TR% * 3 - 3 + PAT%
    GOSUB TRIALLOOP
NEXT PAT%
NEXT TR%
GOTO THANKS

****************** THANK YOU ******************

THANKS:
CLS : COLOR 11
IF SESSION% = 1 THEN
  LOCATE 10, 20: PRINT "Thank you very much! See you tomorrow!"
ELSEIF SESSION% = 2 THEN
  LOCATE 10, 25: PRINT "You will have 120 trials more."
END IF
COLOR 15
END

************************ TRANSFER GOAL PATTERNS ************************

TRNCOD:
FOR P% = 1 TO 3
  FOR X% = 1 TO 600
    TY(P%, X%) = 0
  NEXT X%
NEXT P%

*************** Y COORDINATES ***************
AY(1,1) = 0: AY(1,2) = 35: AY(1,3) = -17.5: AY(1,4) = 0
AY(2,1) = 0: AY(2,2) = 25: AY(2,3) = -12.5: AY(2,4) = 0
AY(3,1) = 0: AY(3,2) = 15: AY(3,3) = -7.5: AY(3,4) = 0

************************ GOAL PATTERNS ************************
PI = 3.141592653589#
FOR P% = 1 TO 3
  ____________________________ SEGMENT 1 ____________________________
  ANGLE = 180 / (18 + P% * 12)
  HALFA = (AY(P%, 2) - AY(P%, 1)) / 2
  FOR X% = 1 TO 18 + P% * 12
    TY(P%, X% + FP%) = AY(P%, 1) + HALFA - HALFA * COS(X% * ANGLE * PI / 80)
  NEXT X%

  ____________________________ SEGMENT 2 ____________________________
  ANGLE = 180 / (45 + P% * 30)
  HALFA = (AY(P%, 3) - AY(P%, 2)) / 2
  FOR X% = 1 TO 45 + P% * 30
    TY(P%, X% + 18 + P% * 12 + FP%) = AY(P%, 2) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
  NEXT X%

  ____________________________ SEGMENT 3 ____________________________
  ANGLE = 180 / (30 + P% * 20)
  HALFA = (AY(P%, 4) - AY(P%, 3)) / 2
  FOR X% = 1 TO 30 + P% * 20
    TY(P%, X% + 63 + P% * 42 + FP%) = AY(P%, 3) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
  NEXT X%
  FOR X% = 1 TO 600
    FSET (X%, TY(P%, X%)), 12
  NEXT X%
NEXT P%
END
CLS
RETURN

************************** BREAK ******************************

BREAK:
BT1 = TIMER: CLS : LOCATE 10, 20: PRINT "Let's take a short break!"
DO: BT2 = TIMER: LOOP UNTIL BT2 - BT1 > 30: CLS : RETURN

******************** TRIAL LOOP *********************
PSET (X%, TY(P%, X%)), 10
NEXT X%
LOCATE 1, 1: PRINT "Trial #:"; TRNO%
LOCATE 2, 1
PRINT "Locate the arm to the start position"
PSET (0,0)
PUT (-5, -1), TAR, XOR
MD% = 3
OUTSIDE:
   DO
      CALL BASDASG(MD%, VARPTR(D%(0)), FLAG%)
      Y = (D%(0) - (POS1% + RANGE% / 2)) * ADUNIT
      IF Y < -23 THEN GOTO OUTSIDE
      IF Y > 38 THEN GOTO OUTSIDE
      PUT (-5, Y - 1), ARM, XOR
      PUT (-5, Y + 1), ARM, XOR
      LOOP UNTIL ABS(Y) <= 1
   TS1 = TIMER
   DO
      CALL BASDASG(MD%, VARPTR(D%(0)), FLAG%)
      Y = (D%(0) - (POS1% + RANGE% / 2)) * ADUNIT
      IF ABS(Y) > 1 THEN GOTO OUTSIDE
      PUT (-5, Y - 1), ARM, XOR
      PUT (-5, Y + 1), ARM, XOR
      LOOP UNTIL TIMER - TS1 > 1
CLS: 'BEEP
   SOUND 500, 2
   FOR S = 1 TO 12000: NEXT S
   SOUND 500, 2
   FOR S = 1 TO 7000: NEXT S
   CALL TRIAL
F1% = 0: ON KEY(1) GOSUB KEYSUB: KEY(1) ON
T2 = TIMER
   CALL FILTER
   FOR X% = 1 TO 600
      ORGY(X%) = (DATAPT%(X%) - (POS1% + RANGE% / 2)) * ADUNIT
      FILTY(X%) = (FILT%(X%) - (POS1% + RANGE% / 2)) * ADUNIT
   NEXT X%
   CALL INITIATION

*** R MS ERROR CALCULATION ********************

   SQDIS = 0
   FOR X% = 1 + FP% TO 124 + P% * 62 + FP%
      SQDIS = SQDIS + (FILTY(X%) - TY(P%, X%))^2
   NEXT X%
   RMS = SQR(SQDIS / (124 + P% * 62))
   DO
      T3 = TIMER
      LOOP UNTIL T3 - T2 > 2

**** KR & KP PRESENTATION ********************

IF SESSION% = 2 THEN GOTO NOKR
   FOR X% = 1 TO 600
      PSET (X%, TY(P%, X%)), 10
      PSET (X%, ORGY(X%)), 14
      PSET (X%, FILTY(X%)), 12
   NEXT X%
   LOCATE 2, 25: PRINT "Error = "; RMS
   LOCATE 2, 32: PRINT USING "####": RMS
NOKR:
IF FI% = 1 THEN GOTO TRIALLOOP

************ DATA FILE ************

IF TRNO% = 0 THEN GOTO NODATA
OPEN "A:\" + N$ + " SE1" FOR APPEND AS #1
FOR X% = 1 TO 600
WRITE #1, ORGY(X%)
NEXT X%
CLOSE #1
NODATA:

************

DO
T4 = TIMER
LOOP UNTIL T4 - T3 > 5
IF TRNO% <> 0 THEN GOTO GOAHEAD
PRINT "Press any key to continue..."
DO
LOOP WHILE INKEY$ = " "
GOAHEAD:
CLS
DO
T5 = TIMER
LOOP UNTIL T5 - T0 > 15
PRINT T5 - T0
RETURN

************ KEYSUB ************

KEYSUB:
FI% = 1
RETURN

************

END
SUB ABORT
LOCATE 22, 1: PRINT "Error FI% in mode X%"
PRINT DASGERR$(FI%)
SYSTEM
END SUB

************ Digital Filtering Sub Program ************

************ Originally written by Dr. Gary D. Heise ************

************ Modified by Hiroshi Sekiya ************

SUB FILTER
SAM = 200: PI = 3.141593
FOR X% = 1 TO 600
ORG(X%) = DATAPT%(X%)
NEXT X%

************ CUTOFF FREQUENCIES SET HERE ************

DSCUT = 5
CUT = DSCUT / .802
WC = TAN(PI * CUT / SAM)
K1 = SQR(2) * WC
K2 = WC ^ 2
A0 = K2 / (1 + K1 + K2)
A1 = 2 * A0
A2 = A0
K3 = 2 * A0 / K2
B1 = -2 * A0 + K3
B2 = 1 - (2 * A0) * K3
FOR X% = 1 TO 600
TEMP(X%) = ORG(X%)
NEXT X%

************
FILT(1) = ORQ(1); FILT(2) = ORQ(2)
FOR X% = 3 TO 600 'FORWARD FILTERING
   FILT(X%) = A0 * TEMP(X%) + A1 * TEMP(X% - 1) + A2 * TEMP(X% - 2) + B1 * HLT(X% - 1) +
   B2 * FILT(X% - 2)
   NEXT X%
   FOR X% = 1 TO 600
   TEMP(X%) = FILT(X%)
   NEXT X%
   FOR X% = 600 - 2 TO 1 STEP 1 'BACKWARD FILTERING
   FILT(X%) = A0 * TEMP(X%) + A1 * TEMP(X% + 1) + A2 * TEMP(X% + 2) + B1 * HLT(X% + 1) +
   B2 * FILT(X% + 2)
   NEXT X%
END SUB

'** Sub Program written by Cindy M. Hadden ********

SUB INITDASG
REM ...........................
REM  Initialize the I/O location of the uCDAS-16G board
REM ...........................
MI>% = 0
FLAG'S = 0
D%(0) = 0
OPEN "C:\METRABT\DASG.ADR" FOR INPUT AS #2
INPUT #2, D%(0)
CLOSE
CALL BASDASG(MI>% FC, VARPTR(D%(0)), RAG%)
IF RAG% o 0 THEN CALL ABORT
REM ...........................
REM  Terminate any previous data collection
REM ...........................
MD% = 7
FLAG'S = 0
D%(0) = 0
CALL BASDASG(MD%, VARPTR(D%(0)), FLAG'S)
IF FLAG'S o 0 THEN CALL ABORT
REM ...........................
REM  Turn off LEDs
REM ...........................
MD% = 13
FLAG'S = 0
D%(0) = 0
CALL BASDASG(MD%, VARPTR(D%(0)), FLAG'S)
IF FLAG'S o 0 THEN CALL ABORT
REM ...........................
REM  Set Channels to be scanned
REM ...........................
MD% = 1
FLAG'S = 0
D%(0) = 1
D%(1) = 1
CALL BASDASG(MD%, VARPTR(D%(0)), FLAG'S)
IF FLAG'S o 0 THEN CALL ABORT
REM ...........................
REM  Initialize timer
REM ...........................
MD% = 17
FLAG'S = 0
D%(0) = 10
D%(1) = 5000
CALL BASDASG(MD%, VARPTR(D%(0)), FLAG%)
IF FLAG% <> 0 THEN CALL ABORT
END SUB

*---------------------------------------------------------------
* Contextual Interference Experiment 4
*---------------------------------------------------------------
*---------------------------------------------------------------
* Data Acquisition Program for Session 2
*---------------------------------------------------------------
*---------------------------------------------------------------
* Programmed by Hiroshi Sekiya
*---------------------------------------------------------------
*---------------------------------------------------------------

DECLARE SUB ABORT ()
DECLARE SUB BASDASG (MD%, BYVAL dummy%, FLAG%)
DECLARE SUB INITDASG ()
DECLARE SUB TRIAL ()
DECLARE SUB FILTER ()
DECLARE SUB INITIATION ()
REM .................................................................
REM ----- Initialize variables
REM
DIM D%(16) 'DASG PARMS
DIM DATAPT%(600) 'Data points collected by DASG
DIM CHANNEL%(1000) 'Channels from which data points were collected
DIM DASGERR$(28) 'DASG error messages
DIM SHARED AY(3, 4) AS INTEGER
DIM SHARED TY(3, 600)
DIM SHARED TAR(900) AS INTEGER, ARM(900) AS INTEGER
DIM SHARED COEF(5), ORG(600), FILT(600), TEMP(600), X(600)
DIM SHARED ORGY(600), FILTY(600), Y(600)
COMMON SHARED COEF(5), ORG(600), FILT(600), TEMP(600), X(600)
COMMON SHARED ORGY(600), FILTY(600), Y(600)
COMMON SHARED MD%, FLAG%
COMMON SHARED NBRTRIAL%, NBRSAMPLE%, TCOUNTER%, FILENAME$
COMMON SHARED C%, BC%
CLEAR : KEY OFF
MD% = 0
FLAG% = 0
NBRTRIAL% = 10
NBRSAMPLE% = 600
REM .................................................................
REM ----- Initialize error messages
REM
OPEN "C:\cindy\programs\dsagerr.dat" FOR INPUT AS #1
FOR I% = 0 TO 28
  INPUT #1, DASGERR$(1%)
NEXT I%
CLOSE #1
REM .................................................................
REM ----- Initialize the uCDAS-16G board for data collection
REM .................................................................
CALL INITDASG
'**********************************************************
* ARM & TARGET IMAGE: 
**********************************************************
SCREEN 12: WINDOW (-9, -25)-(630, 40) CLS
CIRCLE (0,0), 5, 10: GET (-5, 1)-(5, -1), TAR: CLS
LINE (-5,0)-(5,0), 12
LINE (0,-1)-(0, 1), 12: 'LINE (-1, 1)-(-1, 1), 12: LINE (1, -1)-(1, 1), 12
GET (-5, 1)-(5, -1), ARM: CLS
REM .................................................................
REM ----- CALIBRATION
REM ........................................................................................

PRINT "Locate the arm at position 1 then press any key to continue..." DO LOOP WHILE INKEY$ = ""
MD% = 3: FLAG% = 0: D%(0) = 0 CALL BASDASO(MD%, VARPTR(D%(0)), FLAG%)
POS1% = D%(0): PRINT D%(0)
IF FLAG% <> 0 THEN CALL ABORT
PRINT "Locate the arm at position 2 then press any key to continue..."
DO LOOP WHILE INKEY$ = ""
MD% = 3: FLAG% = 0: D%(0) = 0 CALL BASDASO(MD%, VARPTR(D%(0)), FLAG%)
POS2% = D%(0): PRINT D%(0)
IF FLAG% <> 0 THEN CALL ABORT
RANGE% = ABS(POS2% - POS1%): PRINT "RANGE = ", RANGE% ADJUN1 = 90 / RANGE%
GOTO hiro
PRINT "Press any key to continue..." DO LOOP WHILE INKEY$ = ""
REM -----------------------------------------------
REM Prompt for subject's record
REM ..................................................................
SCREEN 2
INPUT "NAME"; N$: PRINT
PRINT "SESSION"
INPUT " Acquisition ---> 1" "
INPUT " Retention ---> 2", SESSION%: PRINT
IF SESSION% = 2 THEN GOTO DREAD
PRINT "SEX"
PRINT " Male ---> 1"
INPUT " Female ---> 2", SEX% : PRINT
INPUT "AGE"; AGE*: PRINT
PRINT "CONDITION"
PRINT " B-B ---> 1"
PRINT " B-S ---> 2"
PRINT " S-B ---> 3"
PRINT " S-S ---> 4", COND%: PRINT
PRINT "SEQUENCE"
PRINT " ABC ---> 1"
PRINT " BCA ---> 2"
INPUT " CAB ---> 3", SEQ%: PRINT
CLS
GOTO SINWAVE
DREAD:
OPEN "A:" + N$ + "$SE2" FOR INPUT AS #1
INPUT #1, SEX%, AGE%, COND%, SEQ%
CLOSE #1: CLS
'**************************** SINE WAVE *****************************

SINWAVE:
SCREEN 12: WINDOW (-9, -25)-(630, 40)
'************************ Y COORDINATES
AY(1, 1) = 0: AY(1, 2) = 30: AY(1, 3) = -15: AY(1, 4) = 0
AY(2, 1) = 0: AY(2, 2) = 20: AY(2, 3) = -10: AY(2, 4) = 0
AY(3, 1) = 0: AY(3, 2) = 10: AY(3, 3) = -5: AY(3, 4) = 0
'************************* GOAL PATTERNS
\[ \pi = 3.141592653589 \]

FOR \( P\% = 1 \) TO \( 3 \)

FP\% = 60

*************** SEGMENT 1 ***********************

\[ \text{ANGLE} = 180 / (24 + P\% \times 12) \]

\[ \text{HALFA} = \left( \text{AY}(P\%, 2) - \text{AY}(P\%, 1) \right) / 2 \]

FOR \( X\% = 1 \) TO 24 + P\% \times 12

\[ \text{TY}(P\%, X\% + FP\%) = \text{AY}(P\%, 1) + \text{HALFA} - \text{HALFA} \times \cos(X\% \times \text{ANGLE} \times \pi / 180) \]

NEXT \( X\% \)

*************** SEGMENT 2 ***********************

\[ \text{ANGLE} = 180 / (60 + P\% \times 30) \]

\[ \text{HALFA} = \left( \text{AY}(P\%, 3) - \text{AY}(P\%, 2) \right) / 2 \]

FOR \( X\% = 1 \) TO 60 + P\% \times 30

\[ \text{TY}(P\%, X\% + 24 + P\% \times 12 + FP\%) = \text{AY}(P\%, 2) + \text{HALFA} - \text{HALFA} \times \cos(X\% \times \text{ANGLE} \times \pi / 180) \]

NEXT \( X\% \)

*************** SEGMENT 3 ***********************

\[ \text{ANGLE} = 180 / (40 + P\% \times 20) \]

\[ \text{HALFA} = \left( \text{AY}(P\%, 4) - \text{AY}(P\%, 3) \right) / 2 \]

FOR \( X\% = 1 \) TO 40 + P\% \times 20

\[ \text{TY}(P\%, X\% + 84 + P\% \times 42 + FP\%) = \text{AY}(P\%, 3) + \text{HALFA} - \text{HALFA} \times \cos(X\% \times \text{ANGLE} \times \pi / 180) \]

NEXT \( X\% \)

FOR \( X\% = 1 \) TO 600

\[ \text{PSET}(X\%, \text{TY}(P\%, X\%)), 10 \]

NEXT \( X\% \)

GOTO TRNCOD

END

CLS

IF SESSION\% = 2 THEN GOTO NOPRACTICE

************** DATA FILE **********************

OPEN "A:\" + NS + "*SE2* FOR OUTPUT AS #1

WRITE #1, SEX\%, AGE\%, COND\%, SEQ\%

CLOSE #1

NOPRACTICE:

IF SESSION\% = 1 THEN TN\% = 40 ELSE TN\% = 5

IF SESSION\% = 1 AND COND\% \leq 2 THEN

GOTO BLOCK

ELSEIF SESSION\% = 1 AND COND\% > 2 THEN

GOTO SERIAL

ELSEIF SESSION\% = 2 AND COND\% MOD 2 \leq 0 THEN

GOTO RBLOCK

ELSEIF SESSION\% = 2 AND COND\% MOD 2 > 0 THEN

GOTO RSERIAL

ELSE

PRINT "ERROR"

END IF

*************** BLOCK ***********************

BLOCK:

FOR BL\% = 1 TO 3

P\% = SEQ\% + BL\% \times 1:IF P\% > 3 THEN P\% = P\% \times 3

FOR TR\% = 1 TO TN\%

TRNO\% = (BL\% \times 1) \times TN\% + TR\%

GOSUB TRIALLOOP

IF TRNO\% MOD 20 = 0 AND TRNO\% < TN\% \times 3 THEN GOSUB BREAK

NEXT TR\%

NEXT BL\%
GOTO THANKS

*.......................... SERIAL ..............................

SERIAL:
FOR TR% = 1 TO TN%
FOR PAT% = 1 TO 3
P% = SEQ% + PAT% - 1: IF P% > 3 THEN P% = P% - 3
TRNO% = TR% * 3 + PAT%
GOSUB TRIALLOOP
    IF TRNO% MOD 20 = 0 AND TRNO% < TN% * 3 THEN GOSUB BREAK
NEXT PAT%
NEXT TR%
GOTO THANKS

*.......................... RET/TRN SERIAL ..............................

RBLOCK:

****** BLOCKED RETENTION TRIALS ***********
FOR BL% = 1 TO 3
P% = SEQ% + BL% - 1: IF P% > 3 THEN P% = P% - 3
FOR TR% = 1 TO TN%
    TRNO% = (BL% - 1) * TN% + TR%
    GOSUB TRIALLOOP
NEXT TR%
NEXT BL%

****** BLOCKED TRANSFER TRIALS ***********
LOCATE 10, 5: PRINT "The next 15 trials will have slightly different patterns."
TRNT = TIMER
DO: LOOP UNTIL TIMER - TRNT > 5: CLS
GOSUB TRNCOD
FOR BL% = 1 TO 3
P% = SEQ% + BL% - 1: IF P% > 3 THEN P% = P% - 3
FOR TR% = 1 TO TN%
    TRNO% = (BL% - 1) * TN% + TR%
    GOSUB TRIALLOOP
NEXT TR%
NEXT BL%
GOTO THANKS

****** SERIAL RETENTION TRIALS ***********
FOR TR% = 1 TO TN%
FOR PAT% = 1 TO 3
P% = SEQ% + PAT% - 1: IF P% > 3 THEN P% = P% - 3
TRNO% = TR% * 3 + PAT%
GOSUB TRIALLOOP
NEXT PAT%
NEXT TR%

****** SERIAL TRANSFER TRIALS ***********
LOCATE 10, 5: PRINT "The next 15 trials will have slightly different patterns."
TRNT = TIMER
DO: LOOP UNTIL TIMER - TRNT > 5: CLS
GOSUB TRNCOD
FOR TR% = 1 TO TN%
FOR PAT% = 1 TO 3
    TRNO% = TN% * 3 + TR% * 3 + PAT%
    GOSUB TRIALLOOP
NEXT PAT%
NEXT TR%
GOTO THANKS
*------------------------ THANK YOU ------------------------*

THANKS:
CLS : COLOR 11
IF SESSION% = 1 THEN
  LOCATE 10, 20: PRINT "Thank you very much! See you tomorrow!"
ELSEIF SESSION% = 2 THEN
  LOCATE 10, 25: PRINT "You will have 180 trials more."
END IF
COLOR 15
END

*------------------------ TRANSFER GOAL PATTERNS ------------------------*

TRNCOD:
FOR P% = 1 TO 3
  FOR X% = 1 TO 600
    TY(P%, X%) = 0
  NEXT X%
NEXT P%

*------------------------ Y COORDINATES ------------------------*

AY(1, 1) = 0: AY(1, 2) = 35: AY(1, 3) = -17.5: AY(1, 4) = 0
AY(2, 1) = 0: AY(2, 2) = 25: AY(2, 3) = -12.5: AY(2, 4) = 0
AY(3, 1) = 0: AY(3, 2) = 15: AY(3, 3) = -7.5: AY(3, 4) = 0

*------------------------ GOAL PATTERNS ------------------------*

PI = 3.141592653589#

FOR P% = 1 TO 3

*------------------------ SEGMENT 1 ------------------------*

ANGLE = 180 / (18 + P% * 12)
HALFA = (AY(P%, 2) - AY(P%, 1)) / 2
FOR X% = 1 TO 18 + P% * 12
  TY(P%, X% + FP%) = AY(P%, 1) + HALFA - HALFA * COS(X% * ANGLE / PI / 180)
NEXT X%

*------------------------ SEGMENT 2 ------------------------*

ANGLE = 180 / (45 + P% * 30)
HALFA = (AY(P%, 2) - AY(P%, 1)) / 2
FOR X% = 1 TO 45 + P% * 30
  TY(P%, X% + 18 + P% * 12 + FP%) = AY(P%, 2) + HALFA - HALFA * COS(X% * ANGLE / PI / 180)
NEXT X%

*------------------------ SEGMENT 3 ------------------------*

ANGLE = 180 / (30 + P% * 20)
HALFA = (AY(P%, 3) - AY(P%, 2)) / 2
FOR X% = 1 TO 30 + P% * 20
  TY(P%, X% + 63 + P% * 42 + FP%) = AY(P%, 3) + HALFA - HALFA * COS(X% * ANGLE / PI / 180)
NEXT X%

FOR X% = 1 TO 600
  SET (X%, TY(P%, X%)), 12
NEXT X%
NEXT P%
END
CLS
RETURN

*------------------------ BREAK ------------------------*

BREAK:
BT1 = TIMER: CLS : LOCATE 10, 20: PRINT "Let's take a short break!"
DO: BT2 = TIMER: LOOP UNTIL BT2 - BT1 > 30: CLS : RETURN

*------------------------ TRIAL LOOP ------------------------*

TRIALLOOP:}

T0 = TIMER
FOR X% = 1 TO 600
PSET (X%, TY(P%, X%)), 10
NEXT X%
LOCATE 1, 1: PRINT "Trial "; TRNO%
LOCATE 2, 1
PRINT "Locate the arm to the start position"
PSET (0, 0)
PUT (-5, -1), ARM, XOR
MD% = 3
OUTSIDE:
DO
CALL BASDASG(MD%, VARPTR(D%(0)), FLAG%)
Y = (D%(0) - (POS1% + RANGE% / 2)) * ADUNIT
IF Y < -23 THEN GOTO OUTSIDE
IF Y > 38 THEN GOTO OUTSIDE
PUT (-5, Y - 1), ARM, XOR
PUT (-5, Y - 1), ARM, XOR
LOOP UNTIL ABS(Y) <= 1
TS1 = TIMER
DO
CALL BASDASG(MD%, VARPTR(D%(0)), FLAG%)
Y = (D%(0) - (POS1% + RANGE% / 2)) * ADUNIT
IF ABS(Y) > 1 THEN GOTO OUTSIDE
PUT (-5, Y - 1), ARM, XOR
PUT (-5, Y - 1), ARM, XOR
LOOP UNTIL TIMER - TS1 > 1
CLS: BEEP
SOUND 500, 2
FOR S = 1 TO 1200: NEXT S
SOUND 500, 2
FOR S = 1 TO 7000: NEXT S
CALL TRIAL
F1% = 0: ON KEY(1) GOSUB KEYSUB: KEY(1) ON
T2 = TIMER
CALL FILTER
FOR X% = 1 TO 600
ORGY(X%) = (DATAPT%(X%) - (POS1% + RANGE% / 2)) * ADUNIT
FILTY(X%) = (FILTY(X%) - (POS1% + RANGE% / 2)) * ADUNIT
NEXT X%
'CALL INITIATION

********************************************************************RMS ERROR CALCULATION********************************************************************

SQDIS = 0
FOR X% = 1 + FP% TO 124 + P% * 62 + FP%
SQDIS = SQDIS + (FILTY(X%) - TY(P%, X%)) ^ 2
NEXT X%
RMS = SQRT(SQDIS / (124 + P% * 62))
DO
T3 = TIMER
LOOP UNTIL T3 - T2 > 2

******************************************************************KR & KP PRESENTATION******************************************************************

IF SESSION% = 2 THEN GOTO NOKR
FOR X% = 1 TO 600
PSET (X%, TY(P%, X%)), 10
PSET (X%, ORGY(X%)), 14
PSET (X%, FILTY(X%)), 12
NEXT X%
LOCATE 2, 25: PRINT "Error = ". RMS
NOKR:
IF F1% = 1 THEN GOTO TRIALLOOP

IF TRNO% = 0 THEN GOTO NODATA
  OPEN "A:\" + N$ + ".SE2" FOR APPEND AS #1
  FOR X% = 1 TO 600
    WRITE #1, ORGY(X%)
  NEXT X%
  CLOSE #1

NODATA:

DO
T4 = TIMER
LOOP UNTIL T4 - T3 > 5
IF TRNO% <= 0 THEN GOTO GOAHEAD
PRINT "Press any key to continue."
DO
LOOP WHILE INKEY$ = "" 

GOAHEAD:
CLS
DO
T5 = TIMER
LOOP UNTIL T5 - T0 > 15
PRINT T5 - T0
RETURN

KEYSUB:
  F1% = 1
RETURN
END

Contextual Interference Experiment 4
Data Acquisition Program for Session 3
Programmed by Hiroshi Sekiya

DECLARE SUB ABORT ()
DECLARE SUB BASDASG (MD%, BYVAL dummy%, FLAG%)
DECLARE SUB INITDASG ()
DECLARE SUB TRIAL ()
DECLARE SUB FILTER ()
DECLARE SUB INITIATION ()
REM ---- Initialize variables

DIM D%(16) * DASG PARMS
DIM DATAPT%(600) * Data points collected by DASG
DIM CHANNEL%(1000) * Channels from which data points were collected
DIM DASGERR$(28) * DASG error messages
DIM SHARED AY(3, 4) AS INTEGER
DIM SHARED TY(3, 600)
DIM SHARED TAR(900) AS INTEGER, ARM(900) AS INTEGER
DIM SHARED COEF(5), ORG(600), FILT(600), TEMP(600), X(600)
DIM SHARED ORGY(600), FILTY(600), Y(600)
COMMON SHARED COEF(), ORG(), FILT(), TEMP(), X()
COMMON SHARED ORGY(), FILTY(), Y()
COMMON SHARED D%(), DATAPT%(), CHANNEL%(), DASGERR$()
COMMON SHARED NBRSAWP%, NBRTRIAL%, TCOUNTER%, FILENAME$  
COMMON SHARED C%, BC%  
CLEAR : KEY OFF  
MD% = 0  
FLAG% = 0  
NBRTRIAL% = 10  
NBRSAWP% = 600  
REM  
REM  Initialize error messages  
REM  
OPEN "C:\cindy\program\dasgerr.dat" FOR INPUT AS #1  
FOR I% = 0 TO 28  
INPUT #1, DASGERR$(I%)  
NEXT I%  
CLOSE #1  
REM  
REM  Initialize the uCDAS-160 board for data collection  
REM  
CALL INITDASG  
'***********************************************************************  
ARM & TARGET IMAGE: ***********************************************************************  
SCREEN 12: WINDOW (-9, -25)-(630, 40): CLS  
CIRCLE (0, 0), 5, 10: GET (-5, 1)-(5, -1), TAR: CLS  
LINE (-5, 0)-(5, 0), 12  
LINE (0, 1)-(0, 1), 12  
LINE (1, 1)-(1, 1), 12  
LINE (1, -1)-(1, 1), 12  
LINE (0, -1)-(5, 1), 12: REM : ARM: CLS  
REM  
REM  CALIBRATION  
REM  
PRINT "Locate the arm at position 1 then press any key to continue ..  
DO  
LOOP WHILE INKEY$ = "  
MD% = 3: FLAG% = 0: D%(0) = 0  
CALL BASDASG(MD%, VARPTR(D%(0)), FLAG%)  
POSI1% = D%(0): PRINT D%(0)  
IF FLAG% <> 0 THEN CALL ABORT  
PRINT "Locate the arm at position 2 then press any key to continue ..  
DO  
LOOP WHILE INKEY$ = "  
MD% = 3: FLAG% = 0: D%(0) = 0  
CALL BASDASG(MD%, VARPTR(D%(0)), FLAG%)  
POSI2% = D%(0): PRINT D%(0)  
IF FLAG% <> 0 THEN CALL ABORT  
RANGE% = ABS(POSI2% - POSI1%): PRINT "RANGE = "; RANGE%;  
ADUNIT = 90 / RANGE%  
GOTO hiro  
PRINT "Press any key to continue ..  
DO  
LOOP WHILE INKEY$ = "  
REM  
REM  Prompt for subject's record  
REM  
SCREEN 2  
INPUT "NAME": N$: PRINT  
PRINT "SESSION"  
PRINT " Acquisition --> 1"  
INPUT " Retention --> 2", SESSION%: PRINT  
IF SESSION% = 2 THEN GOTO DREAD
PRINT "SEX"
PRINT "Male --> 1"
INPUT "Female --> 2", SEX%; PRINT
INPUT "AGE"; AGE%; PRINT
PRINT "CONDITION"
PRINT "B-B --> 1"
PRINT "B-S --> 2"
PRINT "S-B --> 3"
INPUT "S-S --> 4"; COND%; PRINT
PRINT "SEQUENCE"
PRINT "ABC --> 1"
PRINT "BCA --> 2"
INPUT "CAB --> 3"; SBQ%; PRINT
CLS
GOTO SINWAVE

DREAD:
OPEN "A:\" + N$ + " SE3" FOR INPUT AS #1
INPUT #1, SEX%, AGE%, COND%, SBQ%
CLOSE #1: CLS

' ********************************************* SINWAVE *********************************************

SINWAVE:
SCREEN 12: WINDOW (-9, -25)-(630, 40)
'******************************************************** Y COORDINATES ********************************************************
AY(1, 1) = 0: AY(1, 2) = 30: AY(1, 3) = -15: AY(1, 4) = 0
AY(2, 1) = 0: AY(2, 2) = 20: AY(2, 3) = -10: AY(2, 4) = 0
AY(3, 1) = 0: AY(3, 2) = 10: AY(3, 3) = -5: AY(3, 4) = 0
'******************************************************** GOAL PATTERNS ********************************************************
PI = 3.141592653589
FOR P% = 1 TO 3
FP% = 60
'******************************************************** SEGMENT 1 ********************************************************
ANGLE = 180 / (24 + P% * 12)
HALFA = (AY(P%, 2) - AY(P%, 1)) / 2
FOR X% = 1 TO 24 + P% * 12
TY(P%, X% + FP%) = AY(P%, 1) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%
'******************************************************** SEGMENT 2 ********************************************************
ANGLE = 180 / (60 + P% * 30)
HALFA = (AY(P%, 3) - AY(P%, 2)) / 2
FOR X% = 1 TO 60 + P% * 30
TY(P%, X% + 24 + P% * 12 + FP%) = AY(P%, 2) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%
'******************************************************** SEGMENT 3 ********************************************************
ANGLE = 180 / (40 + P% * 20)
HALFA = (AY(P%, 4) - AY(P%, 3)) / 2
FOR X% = 1 TO 40 + P% * 20
TY(P%, X% + 84 + P% * 42 + FP%) = AY(P%, 3) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%
FOR X% = 1 TO 600
PSET (X%, TY(P%, X%)), 10
NEXT X%
NEXT P%
GOTO TRNCCOD
*END
CLS
IF SESSION% = 2 THEN GOTO NOPRACTICE
**DATA FILE**

```
OPEN "A:\" + N$ + ":SE3" FOR OUTPUT AS #1
WRITE #1, SEX%, AGE%, COND%, SEQ%
CLOSE #1
```

**NOPRACTICE:***

```
IF SESSION% = 1 THEN TN% = 60 ELSE TN% = 5
IF SESSION% = 1 AND COND% <= 2 THEN
GOTO BLOCK
ELSEIF SESSION% = 1 AND COND% > 2 THEN
GOTO SERIAL
ELSEIF SESSION% = 2 AND COND% MOD 2 < 0 THEN
GOTO RBLOCK
ELSEIF SESSION% = 2 AND COND% MOD 2 = 0 THEN
GOTO KSERIAL
ELSE
PRINT "ERROR"
END IF
```

**BLOCK:***

```
FOR BL% = 1 TO 3
P% = SEQ% + BL% * 1: IF P% > 3 THEN P% = P% - 3
FOR TR% = 1 TO TN%
TRNO% = (BL% - 1) * TN% + TR%
GOSUB TRIALLOOP
IF TRNO% MOD 20 = 0 AND TRNO% < TN% * 3 THEN GOSUB BREAK
NEXT TR%
NEXT BL%
GOTO THANKS
```

**SERIAL:***

```
FOR TR% = 1 TO TN%
FOR PAT% = 1 TO 3
P% = SEQ% + PAT% - 1: IF P% > 3 THEN P% = P% - 3
TRNO% = TR% * 3 + PAT%
GOSUB TRIALLOOP
IF TRNO% MOD 20 = 0 AND TRNO% < TN% * 3 THEN GOSUB BREAK
NEXT PAT%
NEXT TR%
GOTO THANKS
```

**REJTTRN BLOCK:***

```
FOR BL% = 1 TO 3
P% = SEQ% + BL% * 1: IF P% > 3 THEN P% = P% - 3
FOR TR% = 1 TO TN%
TRNO% = (BL% - 1) * TN% + TR%
GOSUB TRIALLOOP
NEXT TR%
NEXT BL%
```

**NEXT BLOCK:***

```
LOCATE 10, 5: PRINT "The next 15 trials will have slightly different patterns."
TRNT = TIMER
DO: LOOP UNTIL TIMER - TRNT > 5: CLS
GOSUB TRNCOD
FOR BL% = 1 TO 3
P% = SEQ% + BL% * 1: IF P% > 3 THEN P% = P% - 3
FOR TR% = 1 TO TN%
TRNO% = TN% * 3 + (BL% - 1) * TN% + TR%
```
GOSUB TRIALLOOP
NEXT TR%
NEXT BL%
GOTO THANKS

********** SERIAL TRANSFER TRIALS **********

LOCATE 10, 5: PRINT "The next 15 trials will have slightly different patterns."
TRNT = TIMER
DO: LOOP UNTIL TIMER - TRNT > 5: CLS
GOSUB TRNCOD

THANKS:
CLS: COLOR 11
IF SESSION% = 1 THEN
   LOCATE 10, 20; PRINT "Thank you very much! See you tomorrow!"
ELSEIF SESSION% = 2 THEN
   LOCATE 10, 25: PRINT "Thank you very much! Bye!"
END IF
COLOR 15
END

********** TRANSFER GOAL PATTERNS **********

TRNCOD:
FOR P% = 1 TO 3
   FOR X% = 1 TO 600
      TY(P%, X%) = 0
   NEXT X%
NEXT P%

Y COORDINATES

AY(1, 1) = 0: AY(1, 2) = 35: AY(1, 3) = -17.5: AY(1, 4) = 0
AY(2, 1) = 0: AY(2, 2) = 25: AY(2, 3) = -12.5: AY(2, 4) = 0
AY(3, 1) = 0: AY(3, 2) = 15: AY(3, 3) = -7.5: AY(3, 4) = 0

GOAL PATTERNS

PI = 3.141592653589#
FOR P% = 1 TO 3

SEGMENT 1

ANGLE = 180 / (18 + P% * 12)
HALFA = (AY(P%, 2) - AY(P%, 1)) / 2
FOR X% = 1 TO 18 + P% * 12
   TY(P%, X% + FP%) = AY(P%, 1) + HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%

SEGMENT 2
ANGLE = 180 / (45 + P% * 30)
HALFA = (AY(P%, 3) - AY(P%, 2)) / 2
FOR X% = 1 TO 45 + P% * 30
TY(P%, X% + 18 + P% * 12 + FP%) = AY(P%, 2) + HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%

SEGMENT 3

ANGLE = 180 / (30 + P% * 20)
HALFA = (AY(P%, 4) - AY(P%, 3)) / 2
FOR X% = 1 TO 30 + P% * 20
TY(P%, X% + 63 + P% * 42 + FP%) = AY(P%, 3) + HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%
FOR X% = 1 TO 600
PSET (X%, TY(P%, X%)), 12
NEXT X%
NEXT P%
END

RETURN

SEGMENT 3

BREAK

BREAK:
BT1 = TIMER: CLS : LOCATE 10, 20 PRINT "left Uke a ihort break!"
DO: BT2 = TIMER: LOOP UNTIL BT2 - BT1 > 30: CLS : RETURN

TRIAL LOOP:
T0 = TIMER
FOR X% = 1 TO 600
PSET (X%, TY(P%, X%)), 10
NEXT X%
LOCATE 1, 1: PRINT "Trial #: TRNO%"
LOCATE 2, 1
PRINT "Locate the arm to the start position"
PSET (0, 0)
PUT (-5, -1), TAR, XOR
MD% = 3
OUTSIDE:
DO
CALL BASDASG(MD%, VARPTR(D*(0)), FLAG%)
Y = (D*(0) - (POSH% + RANGE% / 2)) * ADUNIT
IF Y < -23 THEN GOTO OUTSIDE
IF Y > 38 THEN GOTO OUTSIDE
PUT (-5, Y - 1), ARM, XOR
PUT (-5, Y - 1), ARM, XOR
LOOP UNTIL ABS(Y) <= 1
TS1 = TIMER
DO
CALL BASDASG(MD%, VARPTR(D*(0)), FLAG%)
Y = (D*(0) - (POSH% + RANGE% / 2)) * ADUNIT
IF ABS(Y) > 1 THEN GOTO OUTSIDE
PUT (-5, Y - 1), ARM, XOR
PUT (-5, Y - 1), ARM, XOR
LOOP UNTIL TIMER - TS1 > 1
CLS : 'BEEP
SOUND 500, 2
FOR S = 1 TO 12000: NEXT S
SOUND 500, 2
FOR S = 1 TO 7000: NEXT S
CALL TRIAL
F1% = 0: ON KEY(1) GOSUB KEYSUB: KEY(1) ON
T2 = TIMER
    CALL FILTER
    FOR X% = 1 TO 600
        ORGY(X%) = (DATAPT%(X%) - (POSI1% + RANGE% / 2)) * ADUNIT
        FILTY(X%) = (FILT%(X%) - (POSI1% + RANGE% / 2)) * ADUNIT
    NEXT X%
    CALL INITIATION

%%%%%%%%%%%%%%%% RMS ERROR CALCULATION %%%%%%%%%%%%%%%%%%
    SQDIS = 0
    FOR X% = 1 TO 124 + P* * 62 + FP*
        SQDIS = SQDIS + (FILTY(X%) - TY(P%, X%)) * 2
    NEXT X%  
    RMS = SQRT(SQDIS / (124 + P* * 62))
DO
    T3 = TIMER
    LOOP UNTIL T3 - T2 > 2

%%%%%%%%%%%%%%%% KR & KP PRESENTATION %%%%%%%%%%%%%%%%%
    IF SESSION% = 2 THEN GOTO NOKR
    FOR X% = 1 TO 600
        PSET (X%, TY(P%, X%)), 10
        PSET (X%, ORGY(X%)), 14
        PSET (X%, HLTY(X%)), 12
    NEXT X%
    LOCATE 2, 25: PRINT "Error = " RMS
    LOCATE 2, 32: PRINT USING "###.##"; RMS
NOKR:
    IF F1% = 1 THEN GOTO TRIALLOOP

%%%%%%%%%%%%%%%% DATA FILE %%%%%%%%%%%%%%%%%
    IF TRNO% = 0 THEN GOTO NODATA
    OPEN "A \ "% + NS + ".SE3" FOR APPEND AS #1
    FOR X% = 1 TO 600
        WRITE #1, ORGY(X%)
    NEXT X%
    CLOSE #1
NODATA:

%%%%%%%%%%%%%%%%
DO
    T4 = TIMER
    LOOP UNTIL T4 - T3 > 5
    IF TRNO% <> 0 THEN GOTO GOAHEAD
    PRINT "Press any key to continue..."
    DO
    LOOP WHILE INKEY$ = ""
GOAHEAD:
    CLS
    DO
    T5 = TIMER
    LOOP UNTIL T5 - T0 > 1.5
    PRINT T5 - T0
    RETURN

%%%%%%%%%%%%%%%% KEYSUB %%%%%%%%%%%%%%%%%
    KEYSUB:
    F1% = 1
    RETURN

END
DECLARE SUB FILTER()
DECLARE FUNCTION BinStr2Bin%(B$)
DECLARE SUB Mouse (m1%, m2%, m3%, m4%)
DECLARE SUB MOUSERANGE (X1%, Y1%, X2%, Y2%)
DECLARE SUB MOUSEPUT (XMOUSE%, YMOUSE%)
DECLARE SUB MouseInches (Horizontal%, Vertical%)
DECLARE SUB MouseInstall (inflag%)
DECLARE SUB MousePressLeft (leftCount%, XMOUSE%, YMOUSE%)
DECLARE SUB MousePressRight (rightCount%, XMOUSE%, YMOUSE%)
DECLARE SUB MouseReleaseLeft (leftCount%, XMOUSE%, YMOUSE%)
DECLARE SUB MouseReleaseRight (rightCount%, XMOUSE%, YMOUSE%)
DECLARE SUB MOUSENOW (LEFTBUTTON%, RIGHTBUTTON%, XMOUSE%, YMOUSE%)
CLEAR : SCREEN 12: WINDOW (-9, -25)-(630, 40): CLS
MouseInstall inflag%
' PRINT "Setting MouseInches to 8 by 11. (8 inches of mouse motion"
' PRINT "across desk to move across screen, and 11 inches vertical"
' PRINT "mouse motion from top to bottom of screen)"
MOUSERANGE 2, -25, 599, 40: MouseInches 2, 18
DIM SHARED ORG(600), FILT(600), TEMP(600)
DIM AY(3, 4) AS INTEGER
DIM HALFA(3, 3)
DIM TY(3, 600)
DIM MOU(1000) AS INTEGER
DIM RMS(3, 70), RMSWOPS(3, 70)
DIM KRM(8), ERM(8), BAD(8)
DIM KRSM(3, 8), ERSM(3, 8), BADDATA(3, 8)
DIM X1(3, 70) AS INTEGER, X2(3, 70) AS INTEGER, X3(3, 70) AS INTEGER, X4(3, 70) AS INTEGER
DIM Y1(3, 70), Y2(3, 70), Y3(3, 70), Y4(3, 70)
* ********** MOUSE & TARGET IMAGE **********************
CLS : LINE (0, -25)-(0, 39), 15: GET (0, 39)-(0, -25), MOU: CLS
* ********** Y COORDINATES **********************
AY(1, 1) = 0: AY(1, 2) = 30: AY(1, 3) = -15: AY(1, 4) = 0
AY(2, 1) = 0: AY(2, 2) = 20: AY(2, 3) = -10: AY(2, 4) = 0
AY(3, 1) = 0: AY(3, 2) = 10: AY(3, 3) = -5: AY(3, 4) = 0
LINE (0, 0)-(600, 0)
* ********** GOAL PATTERNS **********************
P1 = 3.141592653589#
FOR P% = 1 TO 3
P% = 60
* ********** SEGMENT 1 **********************
ANGLE = 180 / (24 + P% * 12)
HALFA = (AY(P%, 2) * AY(P%, 1)) / 2
FOR X% = 1 TO 24 + P% * 12
TY(P%, X% + P%) = AY(P%, 1) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%
* ********** SEGMENT 2 **********************
ANGLE = 180 / (60 + P% * 30)
HALFA = (AY(P%, 3) * AY(P%, 2)) / 2
FOR X% = 1 TO 60 + P% * 30
TY(P%, X% + 24 + P% * 12 + FP%) = AY(P%, 2) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%
ANGLE = 180 / (40 + P\% \times 20)
HALFA = (AY(P\%, 4) - AY(P\%, 3)) / 2
FOR X\% = 1 TO 40 + P\% \times 20
TY(P\%, X\% + 84 + P\% \times 42 + FP\%) = AY(P\%, 3) + HALFA \times HALFA \times \cos(X\% \times ANGLE \times PI / 180)
NEXT X\%
FOR X\% = 1 TO 600
PSET (X\%, TY(P\%, X\%)), 10
NEXT X\%
NEXT P\%
END
CLS

INPUT "NAME"; N\$
INPUT "SESSION (1, 2 or 3)"; SESSION\%

IF SESSION\% = 1 THEN
OPEN "A\%;" + N\$ + "SE1" FOR INPUT AS #1; TN\% = 20
ELSE IF SESSION\% = 2 THEN
OPEN "A\%;" + N\$ + "SE2" FOR INPUT AS #1; TN\% = 40
ELSE
OPEN "A\%;" + N\$ + "SE3" FOR INPUT AS #1; TN\% = 60
END IF

INPUT #1, SEX, AGE, COND, SEQ

FOR BL\% = 1 TO 3
P\% = SEQ + BL\% - 1: IF P\% > 3 THEN P\% = P\% - 3
FOR TR\% = 1 TO TN\%
TRNO\% = (BL\% - 1) \times TN\% + TR\%
GOSUB TRIAL
NEXT TR\%
NEXT BL\%
GOTO RET

SERIAL
FOR TR\% = 1 TO TN\%
FOR PAT\% = 1 TO 3
P\% = TR\% + PAT\% - 1: IF P\% > 3 THEN P\% = P\% - 3
TRNO\% = TR\% \times 3 + 3 + PAT\%
GOSUB TRIAL
NEXT PAT\%
NEXT TR\%

RETBLOCK
FOR BL\% = 1 TO 3
P\% = SEQ + BL\% - 1: IF P\% > 3 THEN P\% = P\% - 3
FOR TR\% = TN\% + 1 TO TN\% + 5
TRNO\% = TN\% \times 3 + (BL\% - 1) \times 5 + TR\% \times TN\%
GOSUB TRIAL
NEXT TR\%
NEXT BL\%
GOSUB TRNCOD
FOR BL% = 1 TO 3
    P% = SEQ + BL% - 1: IF P% > 3 THEN P% = P% - 3
    FOR TR% = TN% + 5 TO TN% + 5
        TRNO% = TN% * 3 + 15 + (BL% - 1) * 5 + TR% - (TN% + 5)
    GOSUB TRIAL
    NEXT TR%
NEXT BL%
GOTO COFILE;

*************** SERIAL. **********************************
RETSERIAL:
FOR TR% = TN% + 1 TO TN% + 5
    FOR PAT% = 1 TO 3
        P% = SEQ + PAT% - 1: IF P% > 3 THEN P% = P% - 3
        TRNO% = TN% * 3 + (TR% - TN%) * 3 - 3 + PAT%
    GOSUB TRIAL
    NEXT PAT%
NEXT TR%
GOSUB TRNCOD
FOR TR% = TN% + 5 + 1 TO TN% + 5 + 5
    FOR PAT% = 1 TO 3
        P% = SEQ + PAT% - 1: IF P% > 3 THEN P% = P% - 3
        TRNO% = TN% * 3 + 15 + (TR% - (TN% + 5)) * 3 + PAT%
    GOSUB TRIAL
    NEXT PAT%
NEXT TR%
GOTO COFILE;

*************** TRIAL. ******************************************************
TRIAL:
FOR X% = 1 TO 600
    INPUT #1, ORG(X%)
    NEXT X%
    CALL FILTER
    CANCEL:
        DO
            MOUSENOW LEFTBUTTON%, RIGHTBUTTON%, XMUSE%, YMUSE%
            LOOP UNTIL LEFTBUTTON% = 0 AND RIGHTBUTTON% = 0
        CLS
        LOCATE 1, 1: PRINT "Trial": TRNO%
    *************** KP *****************************
    FOR X% = 1 TO 600
        PSET (X%, TY(P%, X%)), 10
        PSET (X%, ORG(X%)), 14
        PSET (X%, F1LT(X%)), 12
        NEXT X%
    *************** Ignore the trial *******************************
    PRINT "Left -> go ahead"
    PRINT "Right -> ignore"
        DO
            MOUSENOW LEFTBUTTON%, RIGHTBUTTON%, XMUSE%, YMUSE%
            LOOP UNTIL LEFTBUTTON% = .1 OR RIGHTBUTTON% = .1
        IF RIGHTBUTTON% = .1 THEN
            X1(P%, TR%) = 0: X2(P%, TR%) = 0: X3(P%, TR%) = 0: X4(P%, TR%) = 0
            Y1(P%, TR%) = 0: Y2(P%, TR%) = 0: Y3(P%, TR%) = 0: Y4(P%, TR%) = 0
            RMS(P%, TR%) = 0: RMSWOPS(P%, TR%) = 0: RETURN
        ELSE
            GOTO MAXMIN
        END IF
MAXMIN:

DO
  MOUSENOW LEFTBUTTON%; RIGHTBUTTON%; XMOSUE%; YMOUSE%)
  LOOP UNTIL LEFTBUTTON% = 0 AND RIGHTBUTTON% = 0

GOSUB CPOINT
1% = 0
DO
  1% = 1% + 1
  IF XMOSUE% + 1% > 600 THEN GOTO CANCEL
  LOOP UNTIL FILT(XMOSUE% + 1%) < FILT(XMOSUE% + 1% - 1)
  X1(P%, TR%) = XMOSUE% + 1% - 1
  Y1(P%, TR%) = FILT(XMOSUE% + 1% - 1)
  PSET (XMOSUE% + 1% - 1, FILT(XMOSUE% + 1% - 1)), 11
  PSET (XMOSUE% + 1% - 1, FILT(XMOSUE% + 1% - 1)), 11
  PSET (XMOSUE% + 1% - 1, FILT(XMOSUE% + 1% - 1)), 11
  PSET (XMOSUE% + 1% - 1, FILT(XMOSUE% + 1% - 1)), 11
  PSET (XMOSUE% + 1% - 1, FILT(XMOSUE% + 1% - 1)), 11
  K% = INT((1% + J%) / 2)
  X2(P%, TR%) = XMOSUE% + K% - 1
  Y2(P%, TR%) = FILT(XMOSUE% + K% - 1)
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11

GOSUB CPOINT
1% = 0; J% = 0
DO
  1% = 1% + 1
  IF XMOSUE% + 1% > 600 THEN GOTO CANCEL
  LOOP UNTIL FILT(XMOSUE% + 1%) <= FILT(XMOSUE% + 1% - 1)
  J% = J% + 1
  IF XMOSUE% + J% > 600 THEN GOTO CANCEL
  LOOP UNTIL FILT(XMOSUE% + J%) < FILT(XMOSUE% + J% - 1)
  K% = INT((1% + J%) / 2)
  X3(P%, TR%) = XMOSUE% + K% - 1
  Y3(P%, TR%) = FILT(XMOSUE% + K% - 1)
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11

GOSUB CPOINT
1% = 0; J% = 0
DO
  1% = 1% + 1
  IF XMOSUE% + 1% > 600 THEN GOTO CANCEL
  LOOP UNTIL FILT(XMOSUE% + 1%) >= FILT(XMOSUE% + 1% - 1)
  J% = J% + 1
  IF XMOSUE% + J% > 600 THEN GOTO CANCEL
  LOOP UNTIL FILT(XMOSUE% + J%) <= FILT(XMOSUE% + J% - 1)
  K% = INT((1% + J%) / 2)
  X3(P%, TR%) = XMOSUE% + K% - 1
  Y3(P%, TR%) = FILT(XMOSUE% + K% - 1)
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
  PSET (XMOSUE% + K% - 1, FILT(XMOSUE% + K% - 1)), 11
QOSUB CPOINT

I% = 0
DO
I% = I% + 1
IF XMOUSE% + I% < 1 THEN GOTO CANCEL
LOOP UNTIL FILT(XMOUSE% + I% + 1) - FILT(XMOUSE% + I%) > .02
X4(P%, TR%) = XMOUSE% + I% + 1
Y4(P%, TR%) = FILT(XMOUSE% + I% + 1)
PSET (XMOUSE% + I% + 1, FILT(XMOUSE% + I% + 1)), 11
PSET (XMOUSE% + I% + 1 - 1, FILT(XMOUSE% + I% + 1)), 11
PSET (XMOUSE% + I% + 1 + 1, FILT(XMOUSE% + I% + 1)), 11
PSET (XMOUSE% + I% + 1, FILT(XMOUSE% + I% + 1) - 1), 11
LOCATE 2, 1: PRINT "Click left mouse button to the next trial"
LOCATE 3, 1: PRINT "Click right mouse button to cancel"
DO
MOUSENOW LEFTBUTTON%, RIGHTBUTTON%, XMOUSE%, YMOUSE%
LOOP UNTIL LEFTBUTTON% = -1 OR RIGHTBUTTON% = -1
IF RIGHTBUTTON% = -1 THEN GOTO CANCEL
IF TR% > TN% + 5 THEN GOTO TRNKR
******* RMS ERROR FOR ACQUI & RET ********************
SQDIS = 0
FOR X% = 1 + FP% TO 24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20 + FP%
SQDIS = SQDIS + (FILT(X%) - TY(P%, X%)) ^ 2
NEXT X%
RMS(P%, TR%) = SQR(SQDIS / (24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20))
******* RMS ERROR W/O PHASE SHIFT FOR ACQUI & RET ********************
SQDIS = 0
FOR X% = 1 + FP% TO 24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20 + FP%
XX% = XX% + 1
IF X1(P%, TR%) + XX% > 600 THEN GOTO ERSKIP1
SQDIS = SQDIS + (FILT(X1(P%, TR%) + XX% - 1) - TY(P%, X%)) ^ 2
NEXT X%
ERSKIP1:
RMSWOPS(P%, TR%) = SQR(SQDIS / XX%)
GOTO KREREND
TRNKR:
******* RMS ERROR FOR TRANSFER ********************
SQDIS = 0
FOR X% = 1 + FP% TO 18 + P% * 12 + 45 + P% * 30 + 30 + P% * 20 + FP%
SQDIS = SQDIS + (FILT(X%) - TY(P%, X%)) ^ 2
NEXT X%
RMS(P%, TR%) = SQR(SQDIS / (18 + P% * 12 + 45 + P% * 30 + 30 + P% * 20))
******* RMS ERROR W/O PHASE SHIFT FOR TRANSFER ********************
SQDIS = 0
FOR X% = 1 + FP% TO 18 + P% * 12 + 45 + P% * 30 + 30 + P% * 20 + FP%
XX% = XX% + 1
IF X1(P%, TR%) + XX% > 600 THEN GOTO ERSKIP2
SQDIS = SQDIS + (FILT(X1(P%, TR%) + XX% - 1) - TY(P%, X%)) ^ 2
NEXT X%
ERSKIP2:
RMSWOPS(P%, TR%) = SQR(SQDIS / XX%)
KREREND:
RETURN
****** CPOINT ******
CPOINT:
FOR J% = -1 TO 0
DO
MOUSENOW LEFTBUTTON%, RIGHTBUTTON%, XMOUSE%, YMOUSE%;
PUT (XMOUSE%, -25), MOU, XOR
PUT (XMOUSE%, -25), MOU, XOR
LOOP UNTIL LEFTBUTTON% = J%
NEXT J%
BEEP
RETURN
*************** COORDINATES FILE ***************
COFILE:
CLOSE #1
IF SESSION% = 1 THEN
  OPEN "A:" + N$ + "CD1* FOR OUTPUT AS #1
ELSEIF SESSION% = 2 THEN
  OPEN "A:" + N$ + "CD2* FOR OUTPUT AS #1
ELSE
  OPEN "A:" + N$ + "CD3* FOR OUTPUT AS #1
END IF
WRITE #1, SEX, AGE, COND, SEQ
FOR P% = 1 TO 3
  FOR TR% = 1 TO TN% + 10
    WRITE #1, X1(P%, TR%), Y1(P%, TR%), X2(P%, TR%), Y2(P%, TR%), X3(P%, TR%), Y3(P%, TR%), X4(P%, TR%), Y4(P%, TR%)
  NEXT TR%
NEXT P%
CLOSE #1
*************** RMSE & RMSE W/O PHASE SHIFT ***************
IF SESSION% = 1 THEN
  TN% = 20
ELSEIF SESSION% = 2 THEN
  TN% = 40
ELSE
  TN% = 60
END IF
*************** ACQUISITION ***************
FOR P% = 1 TO 3
  FOR TB% = 1 TO TN% / 10
    C% = 0; KR = 0; ER = 0
    FOR TR% = 1 TO 10
      TR% = TB% * 10 - 10 + T%
      IF X1(P%, TR%) = 0 THEN GOTO SKIPKR
      C% = C% + 1
      KR = KR + RMS(P%, TR%); ER = ER + RMSWOPS(P%, TR%)
    NEXT TR%
    IF C% = 0 THEN
      KRSM(P%, TB%) = KR; ERSM(P%, TB%) = ER
      ELSE
        KRSM(P%, TB%) = KR / C%; ERSM(P%, TB%) = ER / C%
      END IF
    BADDATA(P%, TB%) = 10 - C%
  NEXT TB%
NEXT P%
*************** RETENTION ***************
FOR P% = 1 TO 3
  C% = 0; KR = 0; ER = 0
  FOR TR% = 1 TO 5
    TR% = TN% + T%
    IF X1(P%, TR%) = 0 THEN GOTO SKIPKR
C% = C% + 1
KR = KR + RMS(P%, TR%): ER = ER + RMSWOPS(P%, TR%)

SKIPKR1:
NEXT T%
IF C% = 0 THEN
KRSM(P%, TN% / 10 + 1) = KR: ERSM(P%, TN% / 10 + 1) = ER
ELSE
KRSM(P%, TN% / 10 + 1) = KR / C%: ERSM(P%, TN% / 10 + 1) = ER / C%
END IF
BADDATA(P%, TN% / 10 + 1) = 5 - C%
NEXT P%

********** TRANSFER ***************
FOR P% = 1 TO 3
C% = 0: KR = 0: ER = 0
FOR T%= 1 TO 5
TR% = TN% + 5 + T%
IF X1(P%, TR1 *) = 0 THEN GOTO SKIPKR2
C% = C% + 1
KR = KR + RMS(P%, TR1 *): ER = ER + RMSWOPS(P%, TR1 *)
SKJPKR2:
NEXT T%
IF C% = 0 THEN
KRSM(P%, TN% / 10 + 2) = KR: ERSM(P%, TN% / 10 + 2) = ER
ELSE
KRSM(P%, TN% / 10 + 2) = KR / C%: ERSM(P%, TN% / 10 + 2) = ER / C%
END IF
BADDATA(P%, TN% / 10 + 2) = 5 - C%
NEXT P%
FOR TB% = 1 TO TN% / 10 + 2
KRMB(TB%) = (KRSM(1, TB%) + KRSM(2, TB%) + KRSM(3, TB%)) / 3
ERMB(TB%) = (ERSM(1, TB%) + ERSM(2, TB%) + ERSM(3, TB%)) / 3
BAD(TB%) = (BADDATA(1, TB%) + BADDATA(2, TB%) + BADDATA(3, TB%)) / 3
NEXT TB%

********** PRINT OUT NAME & CONDITION ***************
TITLE:
LPRINT "CT EXPERIMENT W/ARM LEVER"
LPRINT "(TIMING & FORCE: PARAMETER MODIFICATIONS OF THE SAME GMP)"
LPRINT "Subject: ", NS$ 
IF SEX = 1 THEN
LPRINT "Male Age = ", AGE
ELSE
LPRINT "Female Age = ", AGE
END IF
IF COND = 1 THEN
LPRINT "Condition: BB"
ELSEIF COND = 2 THEN
LPRINT "Condition: BS"
ELSEIF COND = 3 THEN
LPRINT "Condition: SB"
ELSE
LPRINT "Condition: SS"
END IF
IF SEQ = 1 THEN
LPRINT "Task order: ABC"
ELSEIF SEQ = 2 THEN
LPRINT "Task order: BCA"
ELSE
LPRINT "Task order: CAB"
END IF
LPRINT
LPRINT "*************** RMS & RMS W/O PHASE SHIFT (degree) ***************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Large amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Small amplitude)"
END IF
LPRINT
LPRINT USING "RMSE: RMSE w/o PS: # of bad trials"
FOR TB% = 1 TO 8
LPRINT USINO "#####" , TB% ; KRM(TB%); ERM(TB%); BADDATA(P%, TB%)
NEXT TB%
NEXT P% 
LPRINT : LPRINT
LPRINT "************************ Mean (RMSE & RMSE W/O PHASE SHIFT) ***************
LPRINT
LPRINT "Trial block", RMSE, "RMSE w/o PS", "# of bad trials"
FOR TB% = 1 TO 8
LPRINT USING "#####", TB%; KRM(TB%); ERM(TB%); BADDATA(P%, TB%)
NEXT TB%
END

*************** TRANSFER GOAL PATTERNS ***************
TRNCOD 
FOR P% = 1 TO 3
FOR X% = 1 TO 600
TY(P%, X%) = 0
NEXT X%
NEXT P%

*************** Y COORDINATES ***************
AY(1, I) = 0; AY(1, 2) = 35; AY(1, 3) = -17.5; AY(1, 4) = 0
AY(2, I) = 0; AY(2, 2) = 25; AY(2, 3) = -12.5; AY(2, 4) = 0
AY(3, I) = 0; AY(3, 2) = 15; AY(3, 3) = -7.5; AY(3, 4) = 0

*************** GOAL PATTERNS ***************
PI = 3.141592653589#
FOR P% = 1 TO 3

*************** SEGMENT 1  ***************
ANGLE = 180 / (18 + P% * 12)
HALFA = (AY(P%, 2) - AY(P%, 1))/2
FOR X% = 1 TO 18 + P% * 12
TY(P%, X% + FP%) = AY(P%, 1) + HALFA - HALFA * COS(X% * ANGIE :) PI / 180)
NEXT X%

*************** SEGMENT 2 ***************
ANGLE = 180 / (45 + P% * 30)
HALFA = (AY(P%, 3) - AY(P%, 2))/2
FOR X% = 1 TO 45 + P% * 30
TY(P%, X% + 18 + P% * 12 + FP%) = AY(P%, 2) + HALFA - HALFA * COS(X% * ANGIE :) PI / 180)
NEXT X%

*************** SEGMENT 3  ***************
ANGLE = 180 / (30 + P% * 20)
HALFA = (AY(P%, 4) - AY(P%, 3))/2
FOR X% = 1 TO 30 + P% * 20
TY(P%, X% + 63 + P% * 42 + FP%) = AY(P%, 3) + HALFA * HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%
FOR X% = 1 TO 600
PSET (X%, TY(P%, X%)), 12
NEXT X%
RETURN

******************************************************************************

WIDTH Contextual Interference Experiment 4
BUFF Error Calculation Program
WIDTH Programmed by Hiroshi Sekiya

DECLARE SUB FILTER ()
DECLARE FUNCTION BinStr2Bin% (B$)
DECLARE SUB Mouse (m1%, m2%, m3%, m4%)
DECLARE SUB MOUSE RANGE (X1%, Y1%, X2%, Y2%)
DECLARE SUB MOUSE PUT (XMUSE%, YMUSE%)
DECLARE SUB Mouse Inches (horizontal%, vertical%)
DECLARE SUB Mouse Install (mflag%)
DECLARE SUB Mouse Press Left (leftCount%, XMUSE%, YMUSE%)
DECLARE SUB Mouse Press Right (rightCount%, XMUSE%, YMUSE%)
DECLARE SUB Mouse Release Left (leftCount%, XMUSE%, YMUSE%)
DECLARE SUB Mouse Release Right (rightCount%, XMUSE%, YMUSE%)
DECLARE SUB Mouse Now (LEFTBUTTON%, RIGHTBUTTON%, XMUSE%, YMUSE%)

CLEAR : SCREEN 12 : WINDOW (-9, -25)-(630, 40) : CLS
Mousel mflag%
' PRINT "Setting Mouse Inches to 8 by 11. (8 inches of mouse motion"
' PRINT "across desk to move across screen, and 11 inches vertical"
' PRINT "mouse motion from top to bottom of screen) ..."
MOUSERANGE 2, -25, 599, 40 : Mouse Inches 2, 18
DIM SHARED ORG(600). FILT(600). TEMP(600)
DIM AY(3, 4) AS INTEGER
DIM HALFA(3, 3)
DIM TY(3, 600), ACC(600), TACC(600)
DIM TACC1(3), TACC2(3), TACC3(3)
DIM TACC1ACQ(3), TACC2ACQ(3), TACC3ACQ(3)
DIM TACC1TRN(3), TACC2TRN(3), TACC3TRN(3)
DIM OTACCACQ(3), OTACCTRN(3)
DIM AOC1(3, 70), ACC2(3, 70), ACC3(3, 70), OACC(3, 70)
DIM MOU(1000) AS INTEGER
DIM RMS(3, 70), RMSWOPS(3, 70), RMS2(3, 70), RMSWOPS2(3, 70)
DIM X(3, 70) AS INTEGER, X2(3, 70) AS INTEGER, X3(3, 70) AS INTEGER, X4(3, 70) AS INTEGER
DIM Y(3, 70), Y2(3, 70), Y3(3, 70), Y4(3, 70)
DIM KRSM(3, 8), ERSM(3, 8), KRM(8), ERM(8)
DIM KRSM2(3, 8), ERSM2(3, 8), KRM2(8), ERM2(8), BAD(8), BADDATA(3, 8)
DIM ATIAE(3, 10), AT2AE(3, 10), AT3AE(3, 10)
DIM AT1CE(3, 10), AT2CE(3, 10), AT3CE(3, 10)
DIM AT1ACE(3, 10), AT2ACE(3, 10), AT3ACE(3, 10)
DIM AT1VE(3, 10), AT2VE(3, 10), AT3VE(3, 10)
DIM AT1IE(3, 10), AT2IE(3, 10), AT3IE(3, 10)
DIM AT1AESM(3, 10), ATACESM(3, 10), ATVESM(3, 10), ATESM(3, 10)
DIM ATIAEM(10), ATACEM(10), ATVEEM(10), ATEM(10)
DIM RTIAE(3, 10), RT2AE(3, 10), RT3AE(3, 10)
DIM RT1CE(3, 10), RT2CE(3, 10), RT3CE(3, 10)
DIM RT1ACE(3, 10), RT2ACE(3, 10), RT3ACE(3, 10)
DIM RTVE(3, 10), RT2VE(3, 10), RT3VE(3, 10)
DIM RT1E(3, 10), RT2E(3, 10), RT3E(3, 10)
DIM RTAEM(3, 10), RTACESM(3, 10), RTVESM(3, 10), RTESM(3, 10)
DIM OTDAE(3, 10), ODACE(3, 10), ODVE(3, 10), ODE(3, 10)
DIM ODAE(3, 10), ODACE(3, 10), ODVE(3, 10), ODE(3, 10)
DIM AF1AE(3, 10), AF2AE(3, 10), AF3AE(3, 10)
DIM AF1CE(3, 10), AF2CE(3, 10), AF3CE(3, 10)
DIM AF1ACE(3, 10), AF2ACE(3, 10), AF3ACE(3, 10)
DIM AF1VE(3, 10), AF2VE(3, 10), AF3VE(3, 10)
DIM AF1E(3, 10), AF2E(3, 10), AF3E(3, 10)
DIM AFAESM(3, 10), AFACESM(3, 10), AFVESM(3, 10), AFESM(3, 10)
DIM AFAEM(3, 10), AFACEM(3, 10), AFVEM(3, 10), AFEM(3, 10)
DIM RFAE(3, 10), RF2AE(3, 10), RF3AE(3, 10)
DIM RF1CE(3, 10), RF2CE(3, 10), RF3CE(3, 10)
DIM RF1ACE(3, 10), RF2ACE(3, 10), RF3ACE(3, 10)
DIM RF1VE(3, 10), RF2VE(3, 10), RF3VE(3, 10)
DIM RF1E(3, 10), RF2E(3, 10), RF3E(3, 10)
DIM RFAESM(3, 10), RFACESM(3, 10), RFVESM(3, 10), RFESM(3, 10)
DIM RFAEM(3, 10), RFACEM(3, 10), RFVEM(3, 10), RFEM(3, 10)
DIM OFAE(3, 10), OFCE(3, 10), OFACE(3, 10), OFVE(3, 10), OFE(3, 10)
DIM OFAE(3, 10), OFCE(3, 10), OFACE(3, 10), OFVE(3, 10), OFE(3, 10)

*************** MOUSE & TARGET IMAGE ***************
CLS : LINE (0, -25) TO (0, 39), 15: GET (0, 39) = (0, -25), MOUSE : CLS

*************** Y COORDINATES ***************
AY(1, 1) = 0: AY(1, 2) = 30: AY(1, 3) = -15: AY(1, 4) = 0
AY(2, 1) = 0: AY(2, 2) = 20: AY(2, 3) = -10: AY(2, 4) = 0
AY(3, 1) = 0: AY(3, 2) = -10: AY(3, 3) = -5: AY(3, 4) = 0
LINE (0, 0) TO (600, 0)

*************** GOAL PATTERNS ***************
PI = 3.141592653589#
FOR P%= 1 TO 3
FP% = 60

*************** SEGMENT 1 ***************
ANGLE = 180 / (24 + P% * 12)
HALFA = (AY(P%, 2) - AY(P%, 1)) / 2
FOR X% = 1 TO 24 + P% * 12
TY(P%, X% + FP%) = AY(P%, 1) + HALFA - HALFA * COS(X% * ANGLE / 180)
NEXT X%

*************** SEGMENT 2 ***************
ANGLE = 180 / (60 + P% * 30)
HALFA = (AY(P%, 3) - AY(P%, 2)) / 2
FOR X% = 1 TO 60 + P% * 30
TY(P%, X% + 24 + P% * 12 + FP%) = AY(P%, 2) + HALFA - HALFA * COS(X% * ANGLE / 180)
NEXT X%

*************** SEGMENT 3 ***************
ANGLE = 180 / (40 + P% * 20)
HALFA = (AY(P%, 4) - AY(P%, 3)) / 2
FOR X% = 1 TO 40 + P% * 20
TY(P%, X% + 84 + P% * 42 + FP%) = AY(P%, 3) + HALFA - HALFA * COS(X% * ANGLE / 180)
NEXT X%
FOR X% = 1 TO 600
PSET (X%, TY(P%, X%)), 10
NEXT X%
NEXT P%
END
CLS

*************** GOAL ACCELERATION (DEGREE/SEC/SEC) ***************

FOR P% = 1 TO 3
FOR X% = 2 TO 599
TACC1(X%) = (TY(P%, X% + 1) - 2 * TY(P%, X%) + TY(P%, X% - 1)) / .005 ^ 2
NEXT X%
TACC1 = 0; TACC2 = 0; TACC3 = 0; OTAOC = 0
FOR X% = FP* TO FP* + 24 + P% * 12
TACC1 = TACC1 + ABS(TACC(X%))
NEXT X%
TACC1(P%) = TACC1 / (24 + P% * 12 + 1)
FOR X% = FP* TO FP* + 24 + P% * 12 TO FP* + 24 + P% * 12 + 60 + P% * .30
TACC2 = TACC2 + ABS(TACC(X%))
NEXT X%
TACC2(P%) = TACC2 / (60 + P% * 30 + 1)
FOR X% = FP* + 24 + P% * 12 + 60 + P% * 30 TO FP* + 24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20
TACC3 = TACC3 + ABS(TACC(X%))
NEXT X%
TACC3(P%) = TACC3 / (40 + P% * 20 + 1)
FOR X% = FP* TO FP* + 24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20
OTAOC = OTAOC + ABS(TACC(X%))
NEXT X%
OTAOC(P%) = OTAOC / (FP* + 24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20 + 1)
NEXT P%

*************** RELATIVE TARGET ACCELERATION ***************

FOR P% = 1 TO 3
TTACC = TACC1(P%) + TACC2(P%) + TACC3(P%)
PRINT TACC1(P%) / TTACC * 100, TACC2(P%) / TTACC * 100, TACC3(P%) / TTACC * 100
TACC1ACQ(P%) = TACC1(P%) / TTACC * 100
TACC2ACQ(P%) = TACC2(P%) / TTACC * 100
TACC3ACQ(P%) = TACC3(P%) / TTACC * 100
NEXT P%

END

*************** INPUT ****************************

INPUT "NAME", N$
INPUT "SESSION", SESSION%

****** COORDINATES FILE ****************************

IF SESSION% = 1 THEN
TN% = 20: OPEN "A:\" + N$ + ".CD1* FOR INPUT AS #1
ELSEIF SESSION% = 2 THEN
TN% = 40: OPEN "A:\" + N$ + ".CD2* FOR INPUT AS #1
ELSE
TN% = 60: OPEN "A:\" + N$ + ".CD3* FOR INPUT AS #1
END IF

INPUT #1. SEX, AGE, COND, SEQ
FOR P% = 1 TO 3
FOR TR% = 1 TO TN% + 10
INPUT #1, X1(P%, TR%), Y1(P%, TR%), X2(P%, TR%), Y2(P%, TR%), X3(P%, TR%), Y3(P%, TR%),
TR%), X4(P%, TR%), Y4(P%, TR%
NEXT TR%
NEXT P%
CLOSE #1

****** DATA FILE ****************************

IF SESSION% = 1 THEN
TN% = 20: OPEN "A:\" + N$ + ".SE1* FOR INPUT AS #1
ELSEIF SESSION% = 2 THEN
TN% = 40: OPEN "A:\" + N$ + ".SE2* FOR INPUT AS #1
ELSE
TN% = 60: OPEN "A:\" + N$ + ".SE3* FOR INPUT AS #1
END IF
ELSE
TN% = 60: OPEN "A:\" + N$ + ".SE3" FOR INPUT AS #1
END IF
INPUT #1, SEX, AGE, COND, SEQ

******************************************************************************************

*ACQUISITION TRIAL ****************************

IF COND <= 2 THEN GOTO BLOCK ELSE GOTO SERIAL

******************************************************************************************

BLOCK:
FOR BL% = 1 TO 3
P% = SEQ + BL% - 1: IF P% > 3 THEN P% = P% - 3
FOR TR% = 1 TO TN%
TRNO% = (BL% - 1) * TN% + TR%
GOSUB TRIAL
NEXT TR%
NEXT BL%
GOTO SERIAL

******************************************************************************************

SERIAL:
FOR TR% = 1 TO TN%
FOR PAT% = 1 TO 3
P% = SEQ + PAT% - 1: IF P% > 3 THEN P% = P% - 3
TRNO% = TR% * 3 - 3 + PAT%
GOSUB TRIAL
NEXT PAT%
NEXT TR%

******************************************************************************************

RE TENTION TRIAL ****************************

RET:
IF COND MOD 2 = I THEN GOTO RETBLOCK ELSE GOTO RETSERIAL

******************************************************************************************

RETBLOCK:
FOR BL% = 1 TO 3
P% = SEQ + BL% - 1: IF P% > 3 THEN P% = P% - 3
FOR TR% = TN% + 1 TO TN% + 5
TRNO% = TN% * 3 + (BL% - 1) * 5 + TR% - TN%
GOSUB TRIAL
NEXT TR%
NEXT BL%
GOSUB TRNCOD

FOR BL% = 1 TO 3
P% = SEQ + BL% - 1: IF P% > 3 THEN P% = P% - 3
FOR TR% = TN% + 5 + 1 TO TN% + 5 + 5
TRNO% = TN% * 3 + 15 + (BL% - 1) * 5 + TR% - (TN% + 5)
GOSUB TRIAL
NEXT TR%
NEXT BL%
GOTO ERRCAL

******************************************************************************************

RETSERIAL:
FOR TR% = TN% + 1 TO TN% + 5
FOR PAT% = 1 TO 3
P% = SEQ + PAT% - 1: IF P% > 3 THEN P% = P% - 3
TRNO% = TN% * 3 + (TR% - TN%) * 3 - 3 + PAT%
GOSUB TRIAL
NEXT PAT%
NEXT TR%
GOSUB TRNCOD
FOR TR% = TN% + 5 + 1 TO TN% + 5 + 5
FOR PAT% = 1 TO 3
P% = SEQ + PAT% - 1: IF P% > 3 THEN P% = P% - 3
TRNO% = TN% * 3 + 15 + (TR% - (TN% + 5)) * 3 - 3 + PAT%
GOSUB TRIAL
NEXT PAT%
NEXT TR%
GOTO ERRCAL

************ TRIAL ************

TRIAL:
FOR X% = 1 TO 600
INPUT #1, ORG(X%)% 
NEXT X%
CALL FILTER
CLS
LOCATE 1, 1: PRINT "Trial #", TRNO%

************ KP ****************

FOR X% = 1 TO 600
PSET (X%, TY(P%, X%)), 10
PSET (X%, ORG(X%)), 14
PSET (X%, FILT(X%)), 12
NEXT X%

******** RMS ERROR (+/- 300 ma) FOR ACQUI & RET ************
IF TR% > TN% + 5 THEN GOTO TRNKR
SQDIS = 0
FOR X% = 1 TO 24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20 + FP% + 60
SQDIS = SQDIS + (FILT(X%) - TY(P%, X%))^2
NEXT X%
RMS(P%, TR%) = SQR(SQDIS / (24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20 + FP% + 60))

******** RMS ERROR W/O PHASE SHIFT (+300 ma) FOR ACQUI & RET ************
SQDIS = 0: XX% = 0
FOR X% = 1 + FP% TO 24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20 + FP% + 60
XX% = XX% + 1
IF X1(P%, TR%) + XX% > 600 THEN GOTO ERSKIP1
SQDIS = SQDIS + (FILT(X1(P%, TR%) + XX% - 1) - TY(P%, X%))^2
NEXT X%
ERSKIP1:
RMSWOPS(P%, TR%) = SQR(SQDIS / XX%)
GOTO KREREND

TRNKR:

******** RMS ERROR (+/- 300 ma) FOR TRANSFER ************
SQDIS = 0
FOR X% = 1 TO 18 + P% * 12 + 45 + P% * 30 + 30 + P% * 20 + FP% + 60
SQDIS = SQDIS + (TILT(X%) - TY(P%, X%))^2
NEXT X%
RMS(P%, TR%) = SQR(SQDIS / (18 + P% * 12 + 45 + P% * 30 + 30 + P% * 20 + FP% + 60))

******** RMS ERROR W/O PHASE SHIFT (+300 ma) FOR TRANSFER ************
SQDIS = 0: XX% = 0
FOR X% = 1 + FP% TO 18 + P% * 12 + 45 + P% * 30 + 30 + P% * 20 + FP% + 60
XX% = XX% + 1
IF X1(P%, TR%) + XX% > 600 THEN GOTO ERSKIP2
SQDIS = SQDIS + (FILT(X1(P%, TR%) + XX% - 1) - TY(P%, X%))^2
NEXT X%
ERSKIP2:
RMSWOPS(P%, TR%) = SQR(SQDIS / XX%)

******** RMS ERROR FOR ACQUI & RET ************
IF TR% > TN% + 5 THEN GOTO TRNKR2
SQDIS = 0
FOR X% = 1 + FP% TO 24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20 + FP%
SQDIS = SQDIS + (FILT(X%) - TY(P%, X%))^2
NEXT X%

RMS2(P%, TR%) = SQR(SQDIS / (24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20))

************ RMS ERROR W/O PHASE SHIFT FOR ACQUISITION ************

SQDIS = 0; XX% = 0
FOR X% = 1 + FP% TO 24 + P% * 12 + 60 + P% * 30 + 40 + P% * 20 + FP%

XX% = XX% + 1
IF X1(P%, TR%) + XX% > 600 THEN GOTO ERSKIP3

SQDIS = SQDIS + (FILT(X1(P%, TR%) + XX% - 1) - TY(P%, X%))^2
NEXT X%

ERSKIP3:
RMSWOPS2(P%, TR%) = SQR(SQDIS / XX%)
GOTO KREJEND2

TRNKR2:

************ RMS ERROR FOR TRANSFER ***********************

SQDIS = 0
FOR X% = 1 + FP% TO 18 + P% * 12 + 45 + P% * 30 + 30 + P% * 20 + FP%

XX% = XX% + 1
IF X1(P%, TR%) + XX% > 600 THEN GOTO ERSKIP4

SQDIS = SQDIS + (FILT(X1(P%, TR%) + XX% - 1) - TY(P%, X%))^2
NEXT X%

ERSKIP4:
RMSWOPS2(P%, TR%) = SQR(SQDIS / XX%)
GOTO KREJEND2

********** SUBJECT'S ACCELERATION ***********************
FOR X% = 2 TO 599

ACC(X%) = (F1LT(X% + 1) - 2 * FH,T(X*) + FILT(X* - 1)) / .005^2
NEXT X%

ACC1 = 0: ACC2 = 0: ACC3 = 0: OACC = 0
FOR X% = X1(P%, TR%) TO X2(P%, TR%)

ACC1 = ACC1 + ABS(ACC(X%))
NEXT X%

ACC1(P%, TR%) = ACC1 / (X2(P%, TR%) - X1(P%, TR%) + 1)
FOR X% = X2(P%, TR%) TO X3(P%, TR%)

ACC2 = ACC2 + ABS(ACC(X%))
NEXT X%

ACC2(P%, TR%) = ACC2 / (X3(P%, TR%) - X2(P%, TR%) + 1)
FOR X% = X3(P%, TR%) TO X4(P%, TR%)

ACC3 = ACC3 + ABS(ACC(X%))
NEXT X%

ACC3(P%, TR%) = ACC3 / (X4(P%, TR%) - X3(P%, TR%) + 1)
FOR X% = X1(P%, TR%) TO X4(P%, TR%)

OACC = OACC + ABS(ACC(X%))
NEXT X%

OACC(P%, TR%) = OACC / (X4(P%, TR%) - X1(P%, TR%) + 1)
RETURN

************* ERROR CALCULATIONS **********************

ERRCAL:
CLOSE #1

************* RMS(+/−300 ms) & RMS(+300 ms) W/O PHASE SHIFT *************

***** ACQUISITION *****
FOR P% = 1 TO 3
FOR TB% = 1 TO TN% / 10
C% = 0: KR = 0: ER = 0
FOR T% = 1 TO 10
TR% = TB% * 10 - 10 + T%
IF XI(P%, TR%) = 0 THEN GOTO SKIPKR1
C% = C% + 1
KR = KR + RMS(P%, TR%): ER = ER + RMSWOPS(P%, TR%)
SKIPKR1:
NEXT T%
KRSM(P%, TB%) = KR / C%: ERSM(P%, TB%) = ER / C%
NEXT TB%
NEXT P%

***** RETENTION *****
FOR P% = 1 TO 3
C% = 0: KR = 0: ER = 0
FOR T% = 1 TO 5
TR% = TN% + T%
IF XI(P%, TR%) = 0 THEN GOTO SKIPKR2
C% = C% + 1
KR = KR + RMS(P%, TR%): ER = ER + RMSWOPS(P%, TR%)
SKIPKR2:
NEXT T%
KRSM(P%, TN% / 10 + 1) = KR / C%: ERSM(P%, TN% / 10 + 1) = ER / C%
NEXT P%

***** TRANSFER *****
FOR P% = 1 TO 3
C% = 0: KR = 0: ER = 0
FOR T% = 1 TO 5
TR% = TN% + 5 + T%
IF XI(P%, TR%) = 0 THEN GOTO SKIPKR3
C% = C% + 1
KR = KR + RMS(P%, TR%): ER = ER + RMSWOPS(P%, TR%)
SKIPKR3:
NEXT T%
KRSM(P%, TN% / 10 + 2) = KR / C%: ERSM(P%, TN% / 10 + 2) = ER / C%
NEXT P%
FOR TB% = 1 TO TN% / 10 + 2
KR(3) = (KRSM(1, TB%) + KRSM(2, TB%) + KRSM(3, TB%)) / 3
ER(3) = (ERSM(1, TB%) + ERSM(2, TB%) + ERSM(3, TB%)) / 3
NEXT TB%

*************** RMS & RMS W/O PHASE SHIFT **********************

***** ACQUISITION *****
FOR P% = 1 TO 3
FOR TB% = 1 TO TN% / 10
C% = 0: KR = 0: ER = 0
FOR T% = 1 TO 10
TR% = TB% * 10 - 10 + T%
IF XI(P%, TR%) = 0 THEN GOTO SKIPKR4
C% = C% + 1
KR = KR + RMS2(P%, TR%): ER = ER + RMSWOPS2(P%, TR%)
SKIPKR4:
NEXT T%
KRSM2(P%, TB%) = KR / C%: ERSM2(P%, TB%) = ER / C%
BADDATA(P%, TB%) = 10 - C%
NEXT TB%
NEXT P%

***** RETENTION *****
FOR P% = 1 TO 3
C% = 0: KR = 0: ER = 0
FOR T% = 1 TO 5
TR% = TN% + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPKR5
C% = C% + 1
KR = KR + RMS2(P%, TR%): ER = ER + RMSWOPS2(P%, TR%)

SKIPKR5:
NEXT T%
KRSM2(P%, TN% / 10 + 1) = KR / C%: ERSM2(P%, TN% / 10 + 1) = ER / C%
BADDATA(P%, TN% / 10 + 1) = 5 - C%
NEXT P%

***** TRANSFER *****
FOR P% = 1 TO 3
C% = 0: KR = 0: ER = 0
FOR T% = 1 TO 5
TR% = TN% + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPKR6
C% = C% + 1
KR = KR + RMS2(P%, TR%): ER = ER + RMSWOPS2(P%, TR%)

SKIPKR6:
NEXT T%
KRSM2(P%, TN% / 10 + 2) = KR / C%: ERSM2(P%, TN% / 10 + 2) = ER / C%
BADDATA(P%, TN% / 10 + 2) = 5 - C%
NEXT P%

FOR TB% = 1 TO TN% / 10 + 2
KRSM2(TB%) = (KRSM2(1, TB%) + KRSM2(2, TB%) + KRSM2(3, TB%)) / 3
ERSM2(TB%) = (ERSM2(1, TB%) + ERSM2(2, TB%) + ERSM2(3, TB%)) / 3
BAD(TB%) = (BADDATA(1, TB%) + BADDATA(2, TB%) + BADDATA(3, TB%)) / 3
NEXT TB%

******* RELATIVE TIMING (%) **********************

***** ACQUISITION *****
FOR P% = 1 TO 3
FOR TB% = 1 TO TN% / 10
C% = 0
S1AE = 0: S2AE = 0: S3AE = 0: S1CE = 0: S2CE = 0: S3CE = 0
S1VEM = 0: S2VEM = 0: S3VEM = 0: S1VE = 0: S2VE = 0: S3VE = 0
FOR T% = 1 TO 10
TR% = TB% * 10 - 10 + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPRT1
C% = C% + 1
TT% = X4(P%, TR%) - X1(P%, TR%)
S1AE = S1AE + ABS((X2(P%, TR%) - X1(P%, TR%)) / TT% * 100 - 19.35484)
S2AE = S2AE + ABS((X3(P%, TR%) - X2(P%, TR%)) / TT% * 100 - 48.3871)
S3AE = S3AE + ABS((X4(P%, TR%) - X3(P%, TR%)) / TT% * 100 - 32.25806)
S1CE = S1CE + ((X2(P%, TR%) - X1(P%, TR%)) / TT% * 100 - 19.35484)
S2CE = S2CE + ((X3(P%, TR%) - X2(P%, TR%)) / TT% * 100 - 48.3871)
S3CE = S3CE + ((X4(P%, TR%) - X3(P%, TR%)) / TT% * 100 - 32.25806)
S1VEM = S1VEM + (X2(P%, TR%) - X1(P%, TR%)) / TT% * 100
S2VEM = S2VEM + (X3(P%, TR%) - X2(P%, TR%)) / TT% * 100
S3VEM = S3VEM + (X4(P%, TR%) - X3(P%, TR%)) / TT% * 100

SKIPRT1:
NEXT T%
FOR T% = 1 TO 10
TR% = TB% * 10 - 10 + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPRT2
TT% = X4(P%, TR%) - X1(P%, TR%)
S1VE = S1VE + ((X2(P%, TR%) - X1(P%, TR%)) / TT% * 100 - (S1VEM / C%)) ^ 2
S2VE = S2VE + ((X3(P%, TR%) - X2(P%, TR%)) / TT% * 100 - (S2VEM / C%)) ^ 2
S3VE = S3VE + \((X4(P\%, TR\%) - X3(P\%, TR\%)) / TT\% \cdot 100 \cdot (S3VEM / C\%)\)^2

**SKIPRT2:**

NEXT T%

\(RT1AE(P\%, TB\%) = S1AE / C\%: RT2AE(P\%, TB\%) = S2AE / C\%: RT3AE(P\%, TB\%) = S3AE / C\%

\(RT1CE(P\%, TB\%) = S1CE / C\%: RT2CE(P\%, TB\%) = S2CE / C\%: RT3CE(P\%, TB\%) = S3CE / C\%

\(RT1ACE(P\%, TB\%) = \text{ABS}(RT1CE(P\%, TB\%)): RT2ACE(P\%, TB\%) = \text{ABS}(RT2CE(P\%, TB\%))

\(RT1VE(P\%, TB\%) = \sqrt{S1VE / C\%}: RT2VE(P\%, TB\%) = \sqrt{S2VE / C\%}: RT3VE(P\%, TB\%) = \sqrt{S3VE / C\%}

\(RT1E(P\%, TB\%) = \sqrt{RT1CE(P\%, TB\%) \cdot RT1VE(P\%, TB\%) \cdot RT1VE(P\%, TB\%)}

\(RT2E(P\%, TB\%) = \sqrt{RT2CE(P\%, TB\%) \cdot RT2VE(P\%, TB\%) \cdot RT2VE(P\%, TB\%)}

\(RT3E(P\%, TB\%) = \sqrt{RT3CE(P\%, TB\%) \cdot RT3VE(P\%, TB\%) \cdot RT3VE(P\%, TB\%)}

\(RT1AESM(P\%, TB\%) = (RT1AE(P\%, TB\%) + RT2AE(P\%, TB\%) + RT3AE(P\%, TB\%)/3

\(RT1CESM(P\%, TB\%) = (RT1CE(P\%, TB\%) + RT2CE(P\%, TB\%) + RT3CE(P\%, TB\%)/3

\(RT1CESM(P\%, TB\%) = (RT1CE(P\%, TB\%) + RT2CE(P\%, TB\%) + RT3CE(P\%, TB\%)/3

\(RT1VESM(P\%, TB\%) = (RT1VE(P\%, TB\%) + RT2VE(P\%, TB\%) + RT3VE(P\%, TB\%)/3

\(RT1ESM(P\%, TB\%) = (RT1E(P\%, TB\%) + RT2E(P\%, TB\%) + RT3E(P\%, TB\%)/3

**NEXT P**

***** RETENTION *****

TB\% = TN\% / 10 + 1

FOR P\% = 1 TO 3

C\% = 0

\(S1AE = 0: S2AE = 0: S3AE = 0: S1CE = 0: S2CE = 0: S3CE = 0

\(S1VEM = 0: S2VEM = 0: S3VEM = 0: S1VE = 0: S2VE = 0: S3VE = 0

FOR T\% = 1 TO 5

TR\% = TN\% + T%

IF X1(P\%, TR\%) = 0 THEN GOTO SKIPRT3

C\% = C\% + 1

TT\% = X4(P\%, TR\%) - X1(P\%, TR\%)

\(S1AE = S1AE + \text{ABS}((X2(P\%, TR\%) - X1(P\%, TR\%)) / TT\% \cdot 100 \cdot 19.35484

\(S2AE = S2AE + \text{ABS}((X3(P\%, TR\%) - X2(P\%, TR\%)) / TT\% \cdot 100 \cdot 48.3871

\(S3AE = S3AE + \text{ABS}((X4(P\%, TR\%) - X3(P\%, TR\%)) / TT\% \cdot 100 \cdot 32.25806

\(S1CE = S1CE + ((X2(P\%, TR\%) - X1(P\%, TR\%)) / TT\% \cdot 100 \cdot 19.35484

\(S2CE = S2CE + ((X3(P\%, TR\%) - X2(P\%, TR\%)) / TT\% \cdot 100 \cdot 48.3871

\(S3CE = S3CE + ((X4(P\%, TR\%) - X3(P\%, TR\%)) / TT\% \cdot 100 \cdot 32.25806

\(S1VEM = S1VEM + (X2(P\%, TR\%) - X1(P\%, TR\%)) / TT\% \cdot 100

\(S2VEM = S2VEM + (X3(P\%, TR\%) - X2(P\%, TR\%)) / TT\% \cdot 100

\(S3VEM = S3VEM + (X4(P\%, TR\%) - X3(P\%, TR\%)) / TT\% \cdot 100

**SKIPRT3:**

NEXT T%

FOR T\% = 1 TO 5

TR\% = TN\% + T%

IF X1(P\%, TR\%) = 0 THEN GOTO SKIPRT4

TT\% = X4(P\%, TR\%) - X1(P\%, TR\%)

\(S1VE = S1VE + ((X2(P\%, TR\%) - X1(P\%, TR\%)) / TT\% \cdot 100 \cdot (S1VEM / C\%) \cdot 2

\(S2VE = S2VE + ((X3(P\%, TR\%) - X2(P\%, TR\%)) / TT\% \cdot 100 \cdot (S2VEM / C\%) \cdot 2

\(S3VE = S3VE + ((X4(P\%, TR\%) - X3(P\%, TR\%)) / TT\% \cdot 100 \cdot (S3VEM / C\%) \cdot 2

**SKIPRT4:**

NEXT T%

\(RT1AE(P\%, TB\%) = S1AE / C\%: RT2AE(P\%, TB\%) = S2AE / C\%: RT3AE(P\%, TB\%) = S3AE / C\%

\(RT1CE(P\%, TB\%) = S1CE / C\%: RT2CE(P\%, TB\%) = S2CE / C\%: RT3CE(P\%, TB\%) = S3CE / C\%

\(RT1ACE(P\%, TB\%) = \text{ABS}(RT1CE(P\%, TB\%)): RT2ACE(P\%, TB\%) = \text{ABS}(RT2CE(P\%, TB\%))

\(RT1VE(P\%, TB\%) = \sqrt{S1VE / C\%}: RT2VE(P\%, TB\%) = \sqrt{S2VE / C\%}: RT3VE(P\%, TB\%) = \sqrt{S3VE / C\%}

\(RT1E(P\%, TB\%) = \sqrt{RT1CE(P\%, TB\%) \cdot RT1VE(P\%, TB\%) \cdot RT1VE(P\%, TB\%)}

\(RT2E(P\%, TB\%) = \sqrt{RT2CE(P\%, TB\%) \cdot RT2VE(P\%, TB\%) \cdot RT2VE(P\%, TB\%)}

\(RT3E(P\%, TB\%) = \sqrt{RT3CE(P\%, TB\%) \cdot RT3VE(P\%, TB\%) \cdot RT3VE(P\%, TB\%})
RTAESM(P%, TB%) = (RT1AE(P%, TB%) + RT2AE(P%, TB%) + RT3AE(P%, TB%)) / 3
RTACESM(P%, TB%) = (RT1ACE(P%, TB%) + RT2ACE(P%, TB%) + RT3ACE(P%, TB%)) / 3
RTVESM(P%, TB%) = (RT1VE(P%, TB%) + RT2VE(P%, TB%) + RT3VE(P%, TB%)) / 3
RTESM(P%, TB%) = (RT1E(P%, TB%) + RT2E(P%, TB%) + RT3E(P%, TB%)) / 3

NEXT P%

***** TRANSFER *****

TB% = TN% / 10 + 2

FOR P% = 1 TO 3

C% = 0
S1AE = 0; S2AE = 0; S3AE = 0; S1CE = 0; S2CE = 0; S3CE = 0
S1VE = 0; S2VE = 0; S3VE = 0; S1VE = 0; S2VE = 0; S3VE = 0

FOR T% = 1 TO 5

TR% = TN% / 5 + T%

IF X1(P%, TR%) = 0 THEN GOTO SKIPRT5

C% = C% + 1

TT% = X4(P%, TR%) - X1(P%, TR%)
S1AE = S1AE + ABS((X2(P%, TR%) - X1(P%, TR%)) / TT% * 100 - 19.35484)
S2AE = S2AE + ABS((X3(P%, TR%) - X2(P%, TR%)) / TT% * 100 - 48.3871)
S3AE = S3AE + ABS((X4(P%, TR%) - X3(P%, TR%)) / TT% * 100 - 32.25806)
S1CE = S1CE + ((X2(P%, TR%) - X1(P%, TR%)) / TT% * 100 - 19.35484)
S2CE = S2CE + ((X3(P%, TR%) - X2(P%, TR%)) / TT% * 100 - 48.3871)
S3CE = S3CE + ((X4(P%, TR%) - X3(P%, TR%)) / TT% * 100 - 32.25806)
S1VE = S1VE + ((X2(P%, TR%) - X1(P%, TR%)) / TT% * 100 - (S1VE / C%) ^ 2)
S2VE = S2VE + ((X3(P%, TR%) - X2(P%, TR%)) / TT% * 100 - (S2VE / C%) ^ 2)
S3VE = S3VE + ((X4(P%, TR%) - X3(P%, TR%)) / TT% * 100 - (S3VE / C%) ^ 2)

SKIPRT5:

NEXT T%

FOR T% = 1 TO 5

TR% = TN% / 5 + T%

IF X1(P%, TR%) = 0 THEN GOTO SKIPRT6

TT% = X4(P%, TR%) - X1(P%, TR%)
S1VE = S1VE + ((X2(P%, TR%) - X1(P%, TR%)) / TT% * 100 - (S1VE / C%) ^ 2)
S2VE = S2VE + ((X3(P%, TR%) - X2(P%, TR%)) / TT% * 100 - (S2VE / C%) ^ 2)
S3VE = S3VE + ((X4(P%, TR%) - X3(P%, TR%)) / TT% * 100 - (S3VE / C%) ^ 2)

SKIPRT6:

NEXT T%

RT1AE(P%, TB%) = S1AE / C%: RT2AE(P%, TB%) = S2AE / C%: RT3AE(P%, TB%) = S3AE / C%
RT1CE(P%, TB%) = S1CE / C%: RT2CE(P%, TB%) = S2CE / C%: RT3CE(P%, TB%) = S3CE / C%
RT1ACE(P%, TB%) = ABS(RT1CE(P%, TB%)): RT2ACE(P%, TB%) = ABS(RT2CE(P%, TB%))
RT3ACE(P%, TB%) = ABS(RT3CE(P%, TB%))
RT1VE(P%, TB%) = SQR(S1VE / C%): RT2VE(P%, TB%) = SQR(S2VE / C%): RT3VE(P%, TB%) = SQR(S3VE / C%)

RT1E(P%, TB%) = SQR(RT1CE(P%, TB%) ^ 2 + RT1VE(P%, TB%) ^ 2)
RT2E(P%, TB%) = SQR(RT2CE(P%, TB%) ^ 2 + RT2VE(P%, TB%) ^ 2)
RT3E(P%, TB%) = SQR(RT3CE(P%, TB%) ^ 2 + RT3VE(P%, TB%) ^ 2)

RTAESM(TB%) = (RT1AE(TB%) + RT2AE(TB%) + RT3AE(TB%)) / 3
RTACESM(TB%) = (RT1ACE(TB%) + RT2ACE(TB%) + RT3ACE(TB%)) / 3
RTVESM(TB%) = (RT1VE(TB%) + RT2VE(TB%) + RT3VE(TB%)) / 3
RTESM(TB%) = (RT1E(TB%) + RT2E(TB%) + RT3E(TB%)) / 3

NEXT P%

FOR TB% = 1 TO TN% / 10 + 2

RTAESM(TB%) = (RTAESM(1, TB%) + RTAESM(2, TB%) + RTAESM(3, TB%)) / 3
RTACESM(TB%) = (RTACESM(1, TB%) + RTACESM(2, TB%) + RTACESM(3, TB%)) / 3
RTVESM(TB%) = (RTVESM(1, TB%) + RTVESM(2, TB%) + RTVESM(3, TB%)) / 3
RTESM(TB%) = (RTESM(1, TB%) + RTESM(2, TB%) + RTESM(3, TB%)) / 3

NEXT TB%

***** OVERALL DURATION (msec) **************

***** ACQUISITION *****
FOR PB% = 1 TO 3
    FOR TB% = 1 TO TN% / 10
        C% = 0
        AE = 0; CE = 0; VEM = 0; VE = 0
        FOR T% = 1 TO 10
            TR% = TB% * 10 - 10 + T%
            IF X1(P%, TR%) = 0 THEN GOTO SKIP0D1
            C% = C% + 1
            AE = AE + ABS((X4(P%, TR%) - X1(P%, TR%)) * 5 - (620 + P% * 310))
            CE = CE + ((X4(P%, TR%) - X1(P%, TR%)) * 5 - (620 + P% * 310))
            VEM = VEM + (X4(P%, TR%) - X1(P%, TR%)) * 5
        SKIPOD1:
        NEXT T%
        FOR T% = 1 TO 10
            TR% = TB% * 10 - 10 + T%
            IF X1(P%, TR%) = 0 THEN GOTO SKIP0D2
            VE = VE + ((X4(P%, TR%) - X1(P%, TR%)) * 5 - (VE / C%)) * 2
        SKIPOD2:
        NEXT T%
        ODAE(P%, TB%) = AE / C%
        ODCCE(P%, TB%) = CE / C%
        ODAE(P%, TB%) = ABS(ODCCE(P%, TB%))
        ODEVE(P%, TB%) = SQR(VE / C%)
        ODE(P%, TB%) = SQR(ODCCE(P%, TB%) ^ 2 + ODEVE(P%, TB%) ^ 2)
        NEXT TB%
        NEXT P%

***** RETENTION *****
TB% = TN% / 10 + 1
FOR PB% = 1 TO 3
    C% = 0
    AE = 0; CE = 0; VEM = 0; VE = 0
    FOR T% = 1 TO 5
        TR% = TN% + T%
        IF X1(P%, TR%) = 0 THEN GOTO SKIP0D3
        C% = C% + 1
        AE = AE + ABS((X4(P%, TR%) - X1(P%, TR%)) * 5 - (620 + P% * 310))
        CE = CE + ((X4(P%, TR%) - X1(P%, TR%)) * 5 - (620 + P% * 310))
        VEM = VEM + (X4(P%, TR%) - X1(P%, TR%)) * 5
    SKIPOD3:
    NEXT T%
    FOR T% = 1 TO 5
        TR% = TN% + T%
        IF X1(P%, TR%) = 0 THEN GOTO SKIP0D4
        VE = VE + ((X4(P%, TR%) - X1(P%, TR%)) * 5 - (VE / C%)) * 2
    SKIPOD4:
    NEXT T%
    ODAE(P%, TB%) = AE / C%
    ODCCE(P%, TB%) = CE / C%
    ODAE(P%, TB%) = ABS(ODCCE(P%, TB%))
    ODEVE(P%, TB%) = SQR(VE / C%)
    ODE(P%, TB%) = SQR(ODCCE(P%, TB%) ^ 2 + ODEVE(P%, TB%) ^ 2)
    NEXT P%

***** TRANSFER *****
TB% = TN% / 10 + 2
FOR PB% = 1 TO 3
    C% = 0
    AE = 0; CE = 0; VEM = 0; VE = 0
    FOR T% = 1 TO 5
TR% = TN% + 5 + T%

IF X1(P%, TR%) = 0 THEN GOTO SKIPOD5

C% = C% + 1

AE = AE + ABS((X4(P%, TR%) - X1(P%, TR%)) * 5 - (465 + P% * 310))

CE = CE + ((X4(P%, TR%) - X1(P%, TR%)) * 5 - (465 + P% * 310))

VEM = VEM + ((X4(P%, TR%) - X1(P%, TR%)) * 5 - (VEM / C%)) * 2

SKIPOD5:

NEXT T%

FOR T% = 1 TO 5

TR% = TN% + 5 + T%

IF X1(P%, TR%) = 0 THEN GOTO SKIPOD6

VE = VE + ((X4(P%, TR%) - X1(P%, TR%)) * 5 - (VEM / C%)) * 2

SKIPOD6:

NEXT T%

ODAE(P%, TB%) = AE / C%

ODCE(P%, TB%) = CE / C%

ODACE(P%, TB%) = ABS(ODCE(P%, TB%))

ODVE(P%, TB%) = SQRT(VE / C%)

ODE(P%, TB%) = SQRT(ODCE(P%, TB%) * 2 + ODVE(P%, TB%) * 2)

NEXT P%

FOR TB% = 1 TO TN% / 10 + 2

ODAEM(TB%) = (ODAE(1, TB%) + ODAE(2, TB%) + ODAE(3, TB%)) / 3

ODACEM(TB%) = (ODACE(1, TB%) + ODACE(2, TB%) + ODACE(3, TB%)) / 3

ODVEM(TB%) = (ODVE(1, TB%) + ODVE(2, TB%) + ODVE(3, TB%)) / 3

ODEM(TB%) = (ODE(1, TB%) + ODE(2, TB%) + ODE(3, TB%)) / 3

NEXT TB%

*************** RELATIVE AVERAGE ACCELERATION (%) ***************

'****** ACQUISITION ******

FOR P% = 1 TO 3

FOR TB% = 1 TO TN% / 10

C% = 0

S1AE = 0; S2AE = 0; S3AE = 0; S1CE = 0; S2CE = 0; S3CE = 0

S1VEM = 0; S2VEM = 0; S3VEM = 0; S1VE = 0; S2VE = 0; S3VE = 0

FOR T% = 1 TO 10

TR% = TB% * 10 - 10 + T%

IF X1(T%, TR%) = 0 THEN GOTO SKIPRFI

C% = C% + 1

TT = ACC1(P%, TR%) + ACC2(P%, TR%) + ACC3(P%, TR%)

S1AE = S1AE + ACC1(P%, TR%) / TT * 100 - TACC1ACQ(P%)

S2AE = S2AE + ACC2(P%, TR%) / TT * 100 - TACC2ACQ(P%)

S3AE = S3AE + ACC3(P%, TR%) / TT * 100 - TACC3ACQ(P%)

S1CE = S1CE + (ACC1(P%, TR%) / TT * 100 - TACC1ACQ(P%))

S2CE = S2CE + (ACC2(P%, TR%) / TT * 100 - TACC2ACQ(P%))

S3CE = S3CE + (ACC3(P%, TR%) / TT * 100 - TACC3ACQ(P%))

S1VEM = S1VEM + ACC1(P%, TR%) / TT * 100

S2VEM = S2VEM + ACC2(P%, TR%) / TT * 100

S3VEM = S3VEM + ACC3(P%, TR%) / TT * 100

SKIPRFI:

NEXT T%

FOR T% = 1 TO 10

TR% = TB% * 10 - 10 + T%

IF X1(T%, TR%) = 0 THEN GOTO SKIPRF2

TT = ACC1(P%, TR%) + ACC2(P%, TR%) + ACC3(P%, TR%)

S1VE = S1VE + (ACC1(P%, TR%) / TT * 100 - (S1VEM / C%)) * 2

S2VE = S2VE + (ACC2(P%, TR%) / TT * 100 - (S2VEM / C%)) * 2

S3VE = S3VE + (ACC3(P%, TR%) / TT * 100 - (S3VEM / C%)) * 2

SKIPRF2:

NEXT T%
RF1AE(P%, TB%) = S1AE / C%: RF2AE(P%, TB%) = S2AE / C%: RF3AE(P%, TB%) = S3AE / C%
RF1CE(P%, TB%) = S1CE / C%: RF2CE(P%, TB%) = S2CE / C%: RF3CE(P%, TB%) = S3CE / C%
RF1ACE(P%, TB%) = ABS(RF1CE(P%, TB%)) : RF2ACE(P%, TB%) = ABS(RF2CE(P%, TB%)):
RF3ACE(P%, TB%) = ABS(RF3CE(P%, TB%))
RF1VE(P%, TB%) = SQR(S1VE / C%): RF2VE(P%, TB%) = SQR(S2VE / C%): RF3VE(P%, TB%) =
SQR(S3VE / C%)
RF1E(P%, TB%) = SQR(RF1CE(P%, TB%)^2 + RF1VE(P%, TB%)^2)
RF2E(P%, TB%) = SQR(RF2CE(P%, TB%)^2 + RF2VE(P%, TB%)^2)
RF3E(P%, TB%) = SQR(RF3CE(P%, TB%)^2 + RF3VE(P%, TB%)^2)
RFAESM(P%, TB%) = (RF1AE(P%, TB%) + RF2AE(P%, TB%) + RF3AE(P%, TB%)) / 3
RFACESM(P%, TB%) = (RF1ACE(P%, TB%) + RF2ACE(P%, TB%) + RF3ACE(P%, TB%)) / 3
RFVESM(P%, TB%) = (RF1VE(P%, TB%) + RF2VE(P%, TB%) + RF3VE(P%, TB%)) / 3
RFESM(P%, TB%) = (RF1E(P%, TB%) + RF2E(P%, TB%) + RF3E(P%, TB%)) / 3
NEXT TB%
****** RETENTION *****
TB% = TN% / 10 + 1
FOR P% = 1 TO 3
C% = 0
S1AE = 0: S2AE = 0: S3AE = 0: S1CE = 0: S2CE = 0: S3CE = 0
S1VE = 0: S2VE = 0: S3VE = 0
FOR T% = 1 TO 5
TR% = TN% + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPRF3
C% = C% + 1
TT = ACC1(P%, TR%) + ACC2(P%, TR%) + ACC3(P%, TR%)
S1AE = S1AE + ABS(ACC1(P%, TR%) / TT * 100 : TACC1ACQ(P%))
S2AE = S2AE + ABS(ACC2(P%, TR%) / TT * 100 : TACC2ACQ(P%))
S3AE = S3AE + ABS(ACC3(P%, TR%) / TT * 100 : TACC3ACQ(P%))
S1CE = S1CE + (ACC1(P%, TR%) / TT * 100 : TACC1ACQ(P%))
S2CE = S2CE + (ACC2(P%, TR%) / TT * 100 : TACC2ACQ(P%))
S3CE = S3CE + (ACC3(P%, TR%) / TT * 100 : TACC3ACQ(P%))
S1VE = S1VE + ACC1(P%, TR%) / TT * 100 - (S1VE / C%)^2
S2VE = S2VE + ACC2(P%, TR%) / TT * 100 - (S2VE / C%)^2
S3VE = S3VE + ACC3(P%, TR%) / TT * 100 - (S3VE / C%)^2
SKIPRF3:
NEXT T%
FOR T% = 1 TO 5
TR% = TN% + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIPRF4
TT = ACC1(P%, TR%) + ACC2(P%, TR%) + ACC3(P%, TR%)
S1VE = S1VE + (ACC1(P%, TR%) / TT * 100 : (S1VE / C%)^2
S2VE = S2VE + (ACC2(P%, TR%) / TT * 100 : (S2VE / C%)^2
S3VE = S3VE + (ACC3(P%, TR%) / TT * 100 : (S3VE / C%)^2
SKIPRF4:
NEXT T%
RF1AE(P%, TB%) = S1AE / C%: RF2AE(P%, TB%) = S2AE / C%: RF3AE(P%, TB%) = S3AE / C%
RF1CE(P%, TB%) = S1CE / C%: RF2CE(P%, TB%) = S2CE / C%: RF3CE(P%, TB%) = S3CE / C%
RF1ACE(P%, TB%) = ABS(RF1CE(P%, TB%)) : RF2ACE(P%, TB%) = ABS(RF2CE(P%, TB%)):
RF3ACE(P%, TB%) = ABS(RF3CE(P%, TB%))
RF1VE(P%, TB%) = SQR(S1VE / C%): RF2VE(P%, TB%) = SQR(S2VE / C%): RF3VE(P%, TB%) =
SQR(S3VE / C%)
RF1E(P%, TB%) = SQR(RF1CE(P%, TB%)^2 + RF1VE(P%, TB%)^2)
RF2E(P%, TB%) = SQR(RF2CE(P%, TB%)^2 + RF2VE(P%, TB%)^2)
RF3E(P%, TB%) = SQR(RF3CE(P%, TB%)^2 + RF3VE(P%, TB%)^2)
RFAESM(P%, TB%) = (RF1AE(P%, TB%) + RF2AE(P%, TB%) + RF3AE(P%, TB%)) / 3
RFACESM(P%, TB%) = (RF1ACE(P%, TB%) + RF2ACE(P%, TB%) + RF3ACE(P%, TB%)) / 3
RFVESM(P%, TB%) = (RF1VE(P%, TB%) + RF2VE(P%, TB%) + RF3VE(P%, TB%)) / 3
RFESM(P\%, TB\%) = (RF1E(P\%, TB\%) + RF2E(P\%, TB\%) + RF3E(P\%, TB\%)) / 3

NEXT P\%

***** TRANSFER *****

TB\% = TN\% / 10 + 2

FOR P\% = 1 TO 3

C\% = 0

S1AE = 0; S2AE = 0; S3AE = 0; S1CE = 0; S2CE = 0; S3CE = 0

S1VEM = 0; S2VEM = 0; S3VEM = 0; S1VE = 0; S2VE = 0; S3VE = 0

FOR T\% = 1 TO 5

TR\% = TN\% + 5 + T\%

IF X1(P\%, TR\%) = 0 THEN GOTO SKIPRF5

C\% = C\% + 1

TT = ACC1(P\%, TR\%) + ACC2(P\%, TR\%) + ACC3(P\%, TR\%)

S1AE = S1AE + ABS(ACC1(P\%, TR\%) / TT * 100 - TACC1TRN(P\%))

S2AE = S2AE + ABS(ACC2(P\%, TR\%) / TT * 100 - TACC2TRN(P\%))

S3AE = S3AE + ABS(ACC3(P\%, TR\%) / TT * 100 - TACC3TRN(P\%))

S1CE = S1CE + (ACC1(P\%, TR\%) / TT * 100 - TACC1TRN(P\%))

S2CE = S2CE + (ACC2(P\%, TR\%) / TT * 100 - TACC2TRN(P\%))

S3CE = S3CE + (ACC3(P\%, TR\%) / TT * 100 - TACC3TRN(P\%))

S1VEM = S1VEM + ACC1(P\%, TR\%) / TT * 100 - (S1VE / C\%) * 2

S2VEM = S2VEM + ACC2(P\%, TR\%) / TT * 100 - (S2VE / C\%) * 2

S3VEM = S3VEM + ACC3(P\%, TR\%) / TT * 100 - (S3VE / C\%) * 2

SKIPRF5:

NEXT T\%

FOR T\% = 1 TO 5

TR\% = TN\% + 5 + T\%

IF X1(P\%, TR\%) = 0 THEN GOTO SKIPRF6

TT = ACC1(P\%, TR\%) + ACC2(P\%, TR\%) + ACC3(P\%, TR\%)

S1VE = S1VE + (ACC1(P\%, TR\%) / TT * 100 - (S1VEM / C\%) ^ 2)

S2VE = S2VE + (ACC2(P\%, TR\%) / TT * 100 - (S2VEM / C\%) ^ 2)

S3VE = S3VE + (ACC3(P\%, TR\%) / TT * 100 - (S3VEM / C\%) ^ 2)

SKIPRF6:

NEXT T\%

RF1AE(P\%, TB\%) = S1AE / C\%; RF2AE(P\%, TB\%) = S2AE / C\%; RF3AE(P\%, TB\%) = S3AE / C\%

RF1CE(P\%, TB\%) = S1CE / C\%; RF2CE(P\%, TB\%) = S2CE / C\%; RF3CE(P\%, TB\%) = S3CE / C\%

RF1ACE(P\%, TB\%) = ABS(RF1CE(P\%, TB\%)) - ABS(RF2CE(P\%, TB\%))

RF3ACE(P\%, TB\%) = ABS(RF3CE(P\%, TB\%))

RF1VE(P\%, TB\%) = SQR(S1VE / C\%); RF2VE(P\%, TB\%) = SQR(S2VE / C\%); RF3VE(P\%, TB\%) = SQR(S3VE / C\%)

RF1E(P\%, TB\%) = SQR(RF1CE(P\%, TB\%) ^ 2 + RF1VE(P\%, TB\%) ^ 2)

RF2E(P\%, TB\%) = SQR(RF2CE(P\%, TB\%) ^ 2 + RF2VE(P\%, TB\%) ^ 2)

RF3E(P\%, TB\%) = SQR(RF3CE(P\%, TB\%) ^ 2 + RF3VE(P\%, TB\%) ^ 2)

RFACESM(P\%, TB\%) = (RF1AE(P\%, TB\%) + RF2AE(P\%, TB\%) + RF3AE(P\%, TB\%)) / 3

RFACESM(P\%, TB\%) = (RF1CE(P\%, TB\%) + RF2CE(P\%, TB\%) + RF3CE(P\%, TB\%)) / 3

RFVEM(P\%, TB\%) = (RF1VE(P\%, TB\%) + RF2VE(P\%, TB\%) + RF3VE(P\%, TB\%)) / 3

NEXT P\%

FOR TB\% = 1 TO TN\% / 10 + 2

RFVEM(TB\%) = (RFVEM(1, TB\%) + RFVEM(2, TB\%) + RFVEM(3, TB\%)) / 3

RFACESM(TB\%) = (RFACESM(1, TB\%) + RFACESM(2, TB\%) + RFACESM(3, TB\%)) / 3

RFVEM(TB\%) = (RFVEM(1, TB\%) + RFVEM(2, TB\%) + RFVEM(3, TB\%)) / 3

NEXT TB\%

******** OVERALL AVERAGE ACCELERATION (degrees/s\(^2\)) **********

***** ACQUISITION *****

FOR P\% = 1 TO 3

FOR TB\% = 1 TO TN\% / 10

C\% = 0

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AE = 0, CE = 0, VEM = 0, VE = 0
FOR T% = 1 TO 10
  TR% = TB% * 10 - 10 + T%
  IF X1(P%, TR%) = 0 THEN GOTO SKIPOF1
  C% = C% + 1
  AE = AE + ABS(OACC(P%, TR%) - OTACCACQ(P%))
  CE = CE + (OACC(P%, TR%) - OTACCACQ(P%))
  VEM = VEM + OACC(P%, TR%)
SKIPOF1:
  NEXT T%
FOR T% = 1 TO 10
  TR% = TB% * 10 - 10 + T%
  IF X1(P%, TR%) = 0 THEN GOTO SKIPOF2
  VE = VE + (OACC(P%, TR%) - VEM / C%) ^ 2
SKIPOF2:
  NEXT T%
OFAE(P%, TB%) = AE / C%
OFCE(P%, TB%) = CE / C%
OFACE(P%, TB%) = ABS(OFCE(P%, TB%))
OFVE(P%, TB%) = SQR(VE / C%)
OTE(P%, TB%) = SQR(OFAE(P%, TB%) ^ 2 + OFVE(P%, TB%) ^ 2)
NEXT TB%
NEXT P%
***** RETENTION *****
TB% = TN% / 10 + 1
FOR P% = 1 TO 3
  C% = 0
  AE = 0, CE = 0, VEM = 0, VE = 0
  FOR T% = 1 TO 5
    TR% = TN% + T%
    IF X1(P%, TR%) = 0 THEN GOTO SKIPOF3
    C% = C% + 1
    AE = AE + ABS(OACC(P%, TR%) - OTACCACQ(P%))
    CE = CE + (OACC(P%, TR%) - OTACCACQ(P%))
    VEM = VEM + OACC(P%, TR%)
SKIPOF3:
  NEXT T%
FOR T% = 1 TO 5
  TR% = TN% + T%
  IF X1(P%, TR%) = 0 THEN GOTO SKIPOF4
  VE = VE + (OACC(P%, TR%) - VEM / C%) ^ 2
SKIPOF4:
  NEXT T%
OFAE(P%, TB%) = AE / C%
OFCE(P%, TB%) = CE / C%
OFACE(P%, TB%) = ABS(OFCE(P%, TB%))
OFVE(P%, TB%) = SQR(VE / C%)
OTE(P%, TB%) = SQR(OFAE(P%, TB%) ^ 2 + OFVE(P%, TB%) ^ 2)
NEXT P%
***** TRANSFER *****
TB% = TN% / 10 + 2
FOR P% = 1 TO 3
  C% = 0
  AE = 0, CE = 0, VEM = 0, VE = 0
  FOR T% = 1 TO 5
    TR% = TN% + 5 + T%
    IF X1(P%, TR%) = 0 THEN GOTO SKIPOF5
    C% = C% + 1
AE = AE + ABS(OACC(P%, TR%) - OTACCTR(N(P%))
CE = CE + (OACC(P%, TR%) - OTACCTR(N(P%))
VEM = VEM + OACC(P%, TR%)

SKIP05:
NEXT T%
FOR T% = 1 TO 5
TR% = TN% + 5 + T%
IF X1(P%, TR%) = 0 THEN GOTO SKIP06
VE = VE + (OACC(P%, TR%) - VEM / C%) ^ 2
SKIP06:
NEXT T%
OFAE(P%, TB%) = AE / C%
OFCE(P%, TB%) = CE / C%
OFACE(P%, TB%) = ABS(OFCE(P%, TB%))
OFVE(P%, TB%) = SQR(VE / C%)
OFPE(P%, TB%) = SQR(OFC(E(P%, TB%) ^ 2 + OFVE(P%, TB%) ^ 2)
NEXT P%
FOR TB% = 1 TO TN% / 10 + 2
OFAEM(TB%) = (OFAE(1, TB%) + OFAE(2, TB%) + OFAE(3, TB%)) / 3
OFACEM(TB%) = (OFACE(1, TB%) + OFACE(2, TB%) + OFACE(3, TB%)) / 3
OFVEM(TB%) = (OFVE(1, TB%) + OFVE(2, TB%) + OFVE(3, TB%)) / 3
OFEM(TB%) = (OFE(1, TB%) + OFE(2, TB%) + OFE(3, TB%)) / 3
NEXT TB%
JUMP:

PRINT OUT

GOSUB TITLE
LPRINT ***************** AE (Relative timing) (%) *******************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Large amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Small amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 8
LPRINT USING "####", TB%; RT1AE(P%, TB%); RT2AE(P%, TB%); RT3AE(P%, TB%);
RTAEM(P%, TB%)
NEXT TB%
NEXT P%
LPRINT
LPRINT **** Mean across Tasks ****
LPRINT "Trial block", " AE "
FOR TB% = 1 TO 8
LPRINT USING "####", TB%; RTAEM(TB%)
NEXT TB%
FOR K% = 1 TO 11: LPRINT : NEXT K%
GOSUB TITLE
LPRINT ***************** CE: (ACE) (Relative timing) (%) *******************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Large amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
   LPRINT "Task C (Small amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean(ACE)"
FOR TB% = 1 TO 8
   LPRINT USING "#####", TB%; RT1CE(P%, TB%); RT2CE(P%, TB%); RT3CE(P%, TB%);
   RTACESM(P%, TB%)
NEXT TB%
NEXT P%
LPRINT
LPRINT ***** Mean across Tasks *****
LPRINT "Trial block", " ACE "
FOR TB% = 1 TO 8
   LPRINT USING "#####", TB%; RTACEM(TB%)
NEXT TB%
FOR K% = 1 TO 11: LPRINT : NEXT K%
GOSUB TITLE
LPRINT ************* VE (Relative timing) (%) *************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
   LPRINT "Task A (Large amplitude)"
ELSEIF P% = 2 THEN
   LPRINT "Task B (Medium amplitude)"
ELSE
   LPRINT "Task C (Small amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 8
   LPRINT USING "#####", TB%; RT1VE(P%, TB%); RT2VE(P%, TB%); RT3VE(P%, TB%);
   RTVESM(P%, TB%)
NEXT TB%
NEXT P%
LPRINT
LPRINT ***** Mean across Tasks *****
LPRINT "Trial block", " VE "
FOR TB% = 1 TO 8
   LPRINT USING "#####", TB%; RTVEM(TB%)
NEXT TB%
FOR K% = 1 TO 11: LPRINT : NEXT K%
GOSUB TITLE
LPRINT ************* 1: (Relative timing) (%) *************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
   LPRINT "Task A (Large amplitude)"
ELSEIF P% = 2 THEN
   LPRINT "Task B (Medium amplitude)"
ELSE
   LPRINT "Task C (Small amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 8
   LPRINT USING "#####", TB%; RT1E(P%, TB%); RT2E(P%, TB%); RT3E(P%, TB%);
   RTESM(P%, TB%)

NEXT TB%
NEXT P%
LPRINT
LPRINT **** Mean across Tasks ****
LPRINT "Trial block", "E"
FOR TB% = 1 TO 8
LPRINT USING "#######", TB%; RTEM(TB%)
NEXT TB%
FOR K% = 1 TO 11: LPRINT: NEXT K%
GOSUB TITLE
LPRINT ***************** (Overall duration) (ms) *******************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Large amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Small amplitude)"
END IF
LPRINT
LPRINT "Trial block", "AE", "CE(ACE)", "VE", "E"
FOR TB% = 1 TO 8
LPRINT USING "#######", TB%; ODAE(P%, TB%); ODCE(P%, TB%); ODV(P%, TB%); ODE(P%, TB%)
NEXT TB%
NEXT P%
LPRINT
LPRINT **** Mean across Tasks ****
LPRINT "Trial block", "AE", "ACE", "VE", "E"
FOR TB% = 1 TO 8
LPRINT USING "#######", TB%; ODAE(P%, TB%); ODCE(P%, TB%); ODV(P%, TB%); ODE(P%, TB%)
NEXT TB%
NEXT P%
LPRINT
LPRINT "Trial block", "AE (Relative Ave. Acc.) (%) *******************
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Large amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Small amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 8
LPRINT USING "#######", TB%; RF1AE(P%, TB%); RF2AE(P%, TB%); RF3AE(P%, TB%); RF4AE(P%, TB%)
RFAEEM(P%, TB%)
NEXT TB%
NEXT P%
LPRINT
LPRINT **** Mean across Tasks ****
LPRINT "Trial block", "AE"
FOR TB% = 1 TO 8
LPRINT USING "#######", TB%; RF1AE(TB%)

NEXT TB%
FOR K% = 1 TO 11: LPRINT: NEXT K%
GOSUB TITLE
LPRINT "*************** CE(ACE) (Relative Ave. Acc.) (%) *************** "
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Large amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Small amplitude)"
END IF
LPRINT
LPRINT Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean(ACE)"
FOR TB% = 1 TO 8
LPRINT USING "######## #; TB%; RF1CE(P%, TB%); RF2CE(P%, TB%); RF3CE(P%, TB%); RFACESM(P%, TB%)
NEXT TB%
NEXT P%
LPRINT
LPRINT **** Mean across Tasks ****
LPRINT "Trial block", "ACE"
FOR TB% = 1 TO 8
LPRINT USING "######## #; TB%; RFACESM(TB%)
NEXT TB%
FOR K% = 1 TO 11: LPRINT: NEXT K%
GOSUB TITLE
LPRINT "*************** VE (Relative Ave. Acc.) (%) *************** 
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Large amplitude)"
ELSEIF P% = 2 THEN
LPRINT "Task B (Medium amplitude)"
ELSE
LPRINT "Task C (Small amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 8
LPRINT USING "##### #; TB%; RF1VE(P%, TB%); RF2VE(P%, TB%); RF3VE(P%, TB%); RFVESM(P%, TB%)
NEXT TB%
NEXT P%
LPRINT
LPRINT **** Mean across Tasks ****
LPRINT "Trial block", "VE"
FOR TB% = 1 TO 8
LPRINT USING "##### #; TB%; RFVEMS(TB%)
NEXT TB%
FOR K% = 1 TO 11: LPRINT: NEXT K%
GOSUB TITLE
LPRINT "*************** E (Relative Ave. Acc.) (%) *************** 
FOR P% = 1 TO 3
LPRINT
IF P% = 1 THEN
LPRINT "Task A (Large amplitude)"
ELSE IF P% = 2 THEN
   LPRINT "Task B (Medium amplitude)"
ELSE
   LPRINT "Task C (Small amplitude)"
END IF
LPRINT
LPRINT "Trial block", "Segment 1", "Segment 2", "Segment 3", "Mean"
FOR TB% = 1 TO 8
   LPRINT USING "####### ***; TB% ; RF1E(P%, TB%); RF2E(P%, TB%); RF3E(P%, TB%);
   RFESM(P%, TB%)
NEXT TB%
NEXT P%
LPRINT
LPRINT **** Mean across Tasks ****
LPRINT "Trial block", "E"
FOR TB% = 1 TO 8
   LPRINT USING "####### ***; TB%; RFEM(TB%)
NEXT TB%
FOR K% = 1 TO 11: LPRINT : NEXT K%
GOSUB TITLE
LPRINT ************** (Overall Ave. Acc.) (degree/s/s) **************
FOR P% = 1 TO 3
   LPRINT IF P% = 1 THEN
      LPRINT "Task A (Large amplitude)"
   ELSEIF P% = 2 THEN
      LPRINT "Task B (Medium amplitude)"
   ELSE
      LPRINT "Task C (Small amplitude)"
   END IF
   LPRINT "Trial block", "AE", "ACE(ACE)", "VE", "E"
   FOR TB% = 1 TO 8
      LPRINT USING "####### ***; TB%; OFAE(P%, TB%); OFCE(P%, TB%); OFVE(P%, TB%);
      OFEM(TB%)
   NEXT TB%
NEXT P%
LPRINT
LPRINT **** Mean across Tasks ****
LPRINT "Trial block", "AE", "ACE", "VE", "E"
FOR TB% = 1 TO 8
   LPRINT USING "####### ***; TB%; OFAE(TB%); OFACEM(TB%); OFVEM(TB%); OFEM(TB%)
NEXT TB%
FOR K% = 1 TO 11: LPRINT : NEXT K%
GOSUB TITLE
LPRINT ******** RMS(+/-300ms) & RMS(+300ms) W/O PHASE SHIFT (degree) ********
FOR P% = 1 TO 3
   LPRINT IF P% = 1 THEN
      LPRINT "Task A (Large amplitude)"
   ELSEIF P% = 2 THEN
      LPRINT "Task B (Medium amplitude)"
   ELSE
      LPRINT "Task C (Small amplitude)"
   END IF
   LPRINT "Trial block", "RMS: " , "RMSE w/o PS"
FOR TB% = 1 TO 8
  LPRINT USING "####.## TB% ; KRSM(TB%); ERM(TB%), BADDATA(TB%)"
NEXT TB%
LPRINT
LPRINT "**** Mean across Tasks ****
LPRINT "Trial block", RMSE *, "RMSE w/o PS", "# of excluded trials"
FOR TB% = 1 TO 8
  LPRINT USING "####.## TB% ; KRSM(TB%); ERM(TB%); BADDATA(TB%)"
NEXT TB%
NEXTP%
LPRINT "Task order: BCA"
ELSE
LPRINT "Task order: CAB"
END IF
LPRINT
RETURN

*************** TRANSFER GOAL PATTERNS ***************

TRNCOD:
FOR P% = 1 TO 3
FOR X% = 1 TO 600
TY(P%, X%) = 0
NEXT X%
NEXT P%

*************** Y COORDINATES ********************
AY(1, 1) = 0: AY(1, 2) = 35: AY(1, 3) = -17.5: AY(1, 4) = 0
AY(2, 1) = 0: AY(2, 2) = 25: AY(2, 3) = -12.5: AY(2, 4) = 0
AY(3, 1) = 0: AY(3, 2) = 15: AY(3, 3) = -7.5: AY(3, 4) = 0

*************** GOAL PATTERNS ***************
PI = 3.141592653589#
FOR P% = 1 TO 3

*************** SEGMENT 1 ***************
ANGLE = 180 / (18 + P% * 12)
HALFA = (AY(P%, 2) - AY(P%, 1)) / 2
FOR X% = 1 TO 18 + P% * 12
TY(P%, X% + FP%) = AY(P%, 1) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%

*************** SEGMENT 2 ***************
ANGLE = 180 / (45 + P% * 30)
HALFA = (AY(P%, 3) - AY(P%, 2)) / 2
FOR X% = 1 TO 45 + P% * 30
TY(P%, X% + 18 + P% * 12 + FP%) = AY(P%, 2) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%

*************** SEGMENT 3 ***************
ANGLE = 180 / (30 + P% * 20)
HALFA = (AY(P%, 4) - AY(P%, 3)) / 2
FOR X% = 1 TO 30 + P% * 20
TY(P%, X% + 63 + P% * 42 + FP%) = AY(P%, 3) + HALFA - HALFA * COS(X% * ANGLE * PI / 180)
NEXT X%
FOR X% = 1 TO 600
PSET (X%, TY(P%, X%)), 12
NEXT X%
NEXT P%

*************** GOAL ACCELERATION (DEGREE/SEC/SEC) ***************
FOR P% = 1 TO 3
FOR X% = 2 TO 599
TACC(X%) = (TY(P%, X% + 1) - 2 * TY(P%, X%) + TY(P%, X% - 1)) / 005 ^ 2
NEXT X%
TACC1 = 0: TACC2 = 0: TACC3 = 0: OTACC = 0
FOR X% = FP% TO FP% + 18 + P% * 12
TACC1 = TACC1 + ABS(TACC(X%))
NEXT X%
TACC1(P%) = TACC1 / (18 + P% * 12 + 1)
FOR X% = FP% + 18 + P% * 12 TO FP% + 18 + P% * 12 + 45 + P% * 30
TACC2 = TACC2 + ABS(TACC(X%))
NEXT X%
TACC2(P%) = TACC2 / (45 + P% * 30 + 1)
FOR X% = FP% + 18 + P% * 12 + 60 + P% * 30 TO FP% + 18 + P% * 12 + 45 + P% * 30 + 30 + P% * 20
TACC3 = TACC3 + ABS(TACC(X%))
NEXT X%
TACC3(P%) = TACC3 / (30 + P% * 20 + 1)
FOR X% = FP% TO FP% + 18 + P% * 12 + 45 + P% * 30 + 30 + P% * 20
OTACC = OTACC + ABS(TACC(X%))
NEXT X%
OTACCTR(N(P%) = OTACC / (FP% + 18 + P% * 12 + 45 + P% * 30 + 30 + P% * 20 + 1)
NEXT P%

********************** RELATIVE TARGET ACCELERATION **********************
FOR P% = 1 TO 3
TTACC = TACC1(P%) + TACC2(P%) + TACC3(P%)
PRINT TACC1(P%) / TTACC * 100, TACC2(P%) / TTACC * 100, TACC3(P%) / TTACC * 100
TACC1TRN(P%) = TACC1(P%) / TTACC * 100
TACC2TRN(P%) = TACC2(P%) / TTACC * 100
TACC3TRN(P%) = TACC3(P%) / TTACC * 100
NEXT P%
RETURN
VITA

Hiroshi Sekiya was born on the 31st of July, 1964 in Izumozaki, Niigata, Japan. The family moved to Kashiwazaki, Niigata three years later, where Hiroshi attended elementary, junior high, and high schools. In 1987, Hiroshi graduated from Niigata University with a Bachelor's Degree in Physical Education. He then moved to Hiroshima, Japan to attend graduate school of Hiroshima University. While he was a graduate student in the Department of Curriculum and Instruction at Hiroshima University, he studied in the Motor Behavior Laboratory at Pennsylvania State University as a visiting student for one year. In 1990, he was awarded a Master of Education from Hiroshima University. In 1992, he moved to Baton Rouge, Louisiana to attend graduate school in the Department of Kinesiology at Louisiana State University. On the 31st of May, 1993 Hiroshi married Rie from Hiroshima, Japan. Rie and Hiroshi have been in Louisiana for three years.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Hiroshi Sekiya

Major Field: Kinesiology

Title of Dissertation: The Contextual Interference Effect in Learning Parameters of the Generalized Motor Program

Approved:

[Signatures]

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

July 12, 1995