The contextual interference effect in persons with traumatic brain injury

Nadia Antonelli
Medical College of Ohio

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Title of Scholarly Project: "The Contextual Interference Effect in Persons with Traumatic Brain Injury"

Submitted by
Nadia Antonelli

In partial fulfillment of the requirements for the degree Master of Occupational Therapy

APPROVED

Name          Signature          Date

Martin S. Rice, Ph.D., OTR/L          12/16/04
Major Advisor

Julie J. Thomas, Ph.D., OTR/L, FAOTA          12/16/04
Department Chair

Christopher E. Bork, Ph.D.          12/16/04
Dean, School of Allied Health

Keith K. Schlender, Ph.D.          12-20-04
Dean, Graduate School

Attachment: Abstract

Final Approval of SP MOT
The contextual interference effect in persons with traumatic brain injury

Nadia Antonelli
The Medical College of Ohio
Abstract

The purpose of the current study was to investigate the contextual interference effect on persons with traumatic brain injury. Fourteen persons with traumatic brain injury were recruited and randomly assigned to either a random practice group or a blocked practice group. The task involved both an acquisition phase and a retention phase. The task involved the manipulation of a computer mouse to click on the targets of three different target patterns of a customized computer software program. The acquisition phase involved 288 trials (mouse clicks) to complete each pattern 12 times each. Following a 10 minute break, the retention phase involved 72 trials (mouse clicks) to complete each of the 3 patterns 3 times each. Separate 2 x 6 (group x trial) analyses of variance (ANOVA) with the factor of trial being repeated were used to analyze the difference between groups during the acquisition phase for the movement time and reaction time. Separate 2 x 3 (group x trial) ANOVAs with the factor of trial being repeated were used to analyze the difference between groups during the retention phase for the movement time and reaction time. No significant difference was found between the random and blocked group for reaction time or movement time during the acquisition phase nor during the retention phase (p > .05). A significant difference was found for the factor of trial within each group regarding reaction time during both the acquisition phase and the retention phase. This study suggests that when presenting a motor task to a client in occupational therapy a high contextual interference practice schedule may not be the most optimal way to present the task. In order to utilize the most effective practice schedule in occupational therapy, further research needs to be conducted in the area of
contextual interference. With additional studies, occupational therapists may have more confidence in providing the appropriate practice schedule to clients in therapy.
Occupational therapy often involves learning specific skills in therapy that will carry over into actual occupations of everyday life. Therapists serve as the teachers to facilitate the learning of those with deficits. It is important that occupational therapists design the practice schedule for optimal learning. Contextual interference is a practice schedule strategy that involves the manipulation of a practice schedule that has been shown to positively effect how well a skill is learned (Pool, 1991). The study of motor learning has many implications for occupational therapy. Therapists teach clients motor skills in practice everyday. The highest performance of motor learning in rehabilitation is reached by using an effective practice schedule (Giuffrida, 1998). Occupational therapy practitioners must take into account the most optimal schedule of practice for their clients to learn motor skills in therapy, such as self-care tasks of dressing, brushing teeth, or bathing. These clients are not the “normal” populations that have been the subjects in much of the motor learning research in the past. The current study investigated different levels of contextual interference and the influence on motor learning performance in a special population.

The rehabilitation process for those who have suffered a traumatic brain injury whether it includes inpatient, outpatient, or residential settings can last for weeks, months, or years (Radomski, 2002). The primary goal for these patients is to become medically stable, reduce physical impairments, acquire basic self-care skills, and eventually acquire instrumental occupations of daily living. Therapists need to know the best way, in terms of efficiency and effectiveness, to teach those who suffered a TBI
those skills they need for successful engagement in the occupations of their choice, from occupations of daily living to instrumental occupations of daily living.

Background

Battig (1966) first introduced the concept of contextual interference in verbal learning at a time in human learning research when the interest in transfer was declining. Transfer refers to the carrying over of skill from a previously learned task and applying these skills to a different task. Battig suggested that previous learning history is one of the most important factors in learning a new task. He thought that by increasing the amount of interference while learning, the acquisition, retention, and transfer of learning a task would be facilitated. High contextual interference refers to a random practice schedule and a low contextual interference refers to blocked practice. For instance, in a blocked practice schedule, one would practice a task for several trials before moving on to the next task. For example in an occupational therapy intervention the patient would practice brushing his or her teeth for several trials before moving on to the next task of shaving. Again the patient would practice shaving for several trials before practicing the next task of washing his or her face. In a random practice schedule, one would practice a set of tasks in a random order without ever practicing the same task repetitively. An occupational therapy intervention using a random practice schedule might include a patient practicing to shave for one trial, then practicing to brush his or her teeth for the next trial, followed by practicing to wash his or her face for the next trial. Battig investigated the idea of contextual interference by having participants learn with either the random or blocked practice schedules (1966, 1972). He found that during the acquisition phase learning was facilitated in the blocked group; however, during the
retention and transfer phases the high contextual interference group (random practice) out
performed the low contextual interference group (blocked practice).

Shea and Morgan (1979) first applied the idea of the contextual interference effect
to motor learning. They had their subjects learn three different tasks involving knocking
down barriers in a specific sequence in response to a stimulus of light. The random
group was presented the tasks in an unsystematic order, while the blocked group was
presented each task in successive trials before moving on to the next task. Shea and
Morgan’s study supported Battig’s idea of the phenomenon that random practice was
favorable over blocked practice.

The contextual interference effect is thought to occur because during high
contextual interference the learner must use cognitive processing skills more often
because of the difficulty associated with the random practice schedule (Shea & Zimny,
1983). It is thought that the learner is required to develop and use more distinctive
memory representations and more elaborate encoding problem-solving processes in the
high contextual interference condition. It has been suggested that high contextual
interference is more beneficial to the learner because of these mental processes (Shea &
Zimny, 1983).

Battig’s theory of the contextual interference effect has been further supported by
numerous subsequent studies (Del Ray, 1989; Del Rey, Wughalter, Whittehurst, &
Barnwell, 1983; Jarus, Wughalter, & Gianutsos, 1997; Lee & Magill, 1983; Wood &
Ging, 1991). Although these studies varied in task, Shea and Morgan’s (1979) original
results were supported. Random practice was found to be more beneficial to the learner
than blocked practice and therefore became the more favored type of practice.
Even though there is an abundance of support for the contextual interference effect, all of these studies lack one aspect that is important to occupational therapy. Namely, the majority of these studies employed relatively simple tasks, using college-aged “normal” participants. However, very little contextual interference research has been done using populations typically seen by occupational therapists. Sabari (1990) noted that those who suffer from hemiplegia practice tasks repetitively in therapy with the goal of improving motor performance. Sabari suggested that those who have impairments in motor memory are limited in their ability to remember newly relearned tasks. For this reason, it was suggested that practice should be repetitive, but also have some variability involved just as the “real” world. Poole (1991) also suggested that a repetitive practice schedule would facilitate acquisition in therapy. She suggested that a blocked practice schedule would improve performance faster in therapy with the drawback that the learner may be less attentive to the task because he or she will know what to expect.

The above mentioned studies have only investigated the contextual interference effect theory on “normal” healthy populations. A limited number of studies have examined contextual interference with special populations (Hanlon, 1996; Heitman & Gilley, 1989; Luce & Rice, 2004).

Heitman and Gilley (1989) studied the contextual interference effect on the population of mentally retarded individuals. These researchers assumed that random practice requires higher level of cognitive processing, therefore, they hypothesized that mentally retarded individuals may not benefit as much from random practice as the normal populations. In their study, 20 mentally retarded children were assigned into
either a blocked practice group or a random practice group and had them perform a novel task involving rotary pursuit practiced at three different speeds. The dependent variable was mean time on the target across blocks of three 20-second trials. Results indicated no significant difference between the two practice groups in terms of mean time, which are incongruent with Shea and Morgan’s (1979) results during the acquisition phase.

Hanlon (1996) studied contextual interference in 24 patients with chronic hemiparesis secondary to a single unilateral stroke. The subjects’ rate of acquisition and retention were measured during a functional movement sequence using the hemiparetic upper limb. The motor sequence involved reaching for targets, such as a cupboard door and a coffee cup that were placed in front of the subjects. The subjects were measured on the successful completion of the motor task. Results indicated a significant difference between the two practice groups on both the first and second retention measures. Although the results supported Shea and Morgan’s (1979) original results that the random group outperformed the blocked practice group, the methodology of the study may have had an effect on the results. Instead of having a set number of practice trials, the subjects were allowed to practice as much as they wanted until they felt comfortable with the task. So, although participants actually demonstrated a certain level of proficiency, the amount of practice each participant received varied among the participants. Hence it’s difficult to say for certain whether their results are attributable to the random-block assignment or to the length of practice that they received.

Luce and Rice (2004) also studied the contextual interference effect on a special population of those who suffered a traumatic brain injury. They examined acquisition, retention, and transfer trials of a novel task similar to the one used in the original Shea
and Morgan (1979) study. The blocked group outperformed the random group during the acquisition phase in terms of task accuracy; however, no significant difference was found between the two groups during the retention or transfer phases in terms of accuracy. Further, no significant differences were found in reaction time or movement time between the two groups in any of the three conditions.

The results of the studies conducted by Heitman and Gilley (1989), Hanlon (1996), and Luce and Rice (2004) question whether or not Shea and Morgan’s original conclusion should apply to those learning motor tasks in occupational therapy. Perhaps, due to the higher level of cognitive processing required during random practice as proposed by Shea and Zimny (1983) those that lack higher cognitive functioning would benefit more from blocked practice.

For instance, Albaret and Thon (1998) found that when the task performed was more complex the high interference condition was not the most beneficial to their subjects. The subjects were from a normal population, and were analyzed on the acquisition, retention, and transfer of learning in a drawing task. Results were that random practice schedules resulted in enhanced performance only using the simplest drawing tasks and not the complex drawing tasks.

Jarus and Gutman (2001) also investigated the complexity of the task in regards to contextual interference in children. Subjects practiced the task of throwing beanbags under high, low, and medium contextual interference in either a complex or simple task. Results indicated that the children in the random group completing the simple task outperformed the blocked group. However, in the complex task, no difference was found between the two practice groups during both the retention and transfer phases.
Mixed results have been found in other studies of the contextual interference effect in children (Jarus & Goverover, 1999; Pollock & Lee, 1997). Pollock and Lee (1997) compared performance in an aiming task during the acquisition, retention, and transfer experimental phases among children and adults. They found that the random practice schedules benefited the adult group, but not in the group of children. Jarus and Goverover (1999) compared different age groups of children (5 years, 7 years, and 11 years of age) and found that the contextual interference effect was not consistent among the different groups. Results may indicate that the complexity of a given task, in terms of how easy or difficult, may have an effect in practice schedule in different age groups. Due to the inconsistency in the above mentioned studies, further investigation of the contextual interference effect is needed, especially within special populations. It may be that a low contextual interference (blocked practice schedule) may be more beneficial to certain populations, especially those who have suffered TBI.

The purpose of the current study was to further investigate the contextual interference effect on special populations. The study questioned the efficacy of using a random over a blocked practice schedule on those who suffered a traumatic brain injury. Based on previous research (Hanlon, 1996; Heitman & Gilley, 1989; Luce & Rice, 2004), it was hypothesized that there will be a difference between the blocked groups and random groups performance during the acquisition phase. It was also hypothesized that there will not be a difference between the blocked group and random group during the retention phase.
Methods

Participants

Fourteen male and female survivors of a traumatic brain injury at least 18 years of age or older were recruited from the Medical College of Ohio Works and local community support groups to participate in this study. Information regarding each participant’s head injury diagnosis, site and date of lesion, and the amount of therapy received was collected. Each participant’s limb dominance was also noted. Each participant was scored on the Disability Rating Scale (Rappaport et al., 1982) assessed by the researcher, the participants’ occupational therapist, or both. The Disability Rating Scale (DRS) is a relatively widely used scale to measure cognitive functioning in persons with traumatic brain injury. The score ranges from zero to 29 with zero reflecting no disability and 29 reflecting the greatest level of disability. Persons with a score between zero and 6 were included in the study. A score of zero indicates "no disability", score of 1 indicates "mild" disability, a score of 2-3 indicates "partial" disability, and a score of 4-6 indicates "moderate" disability (see Appendix). The most pertinent portion of the DRS to the proposed study is the "Arousability, Awareness, and Responsivity" section. Only participants who score "zero" in this section were recruited for this study as these skills (eye opening, communication, and motor response) were crucial for this study. Any persons with significant visual impairments (participants were required to view a computer screen) were excluded from participating in the study.

Apparatus

A customized software program housed in a 366 MHz Pentium II computer was used to acquire and measure reaction time, movement time, and spatial accuracy during
each task. The software program used the computer’s internal clock and time was measured in decaseconds (100 Hz). The computer was positioned on a table in front of the participant. The setup included the computer, a 17 inch monitor (Gateway, San Diego, CA), a Microsoft mouse, a table or desk, and a chair located in a quiet room. The computer mouse was positioned to either the right or left of the participant depending on the participant’s preference.

Procedure

Following approval of the institutional review board and the obtainment of the participant’s informed consent, each participant was randomly assigned to either a blocked or random group assignment by custom random number generating computer software. Nested within each group assignment participants were randomly assigned to 1 of 3 order of presentation groups (e.g., ABC, BCA, or CAB). Each participant was seated at a table in front of the computer, and was given a standard orientation to the computer and mouse. The orientation included a practice trial, which was equivalent in both groups.

Participants saw a target pattern and used the mouse to click on the targets of each pattern. Each pattern contained 5 separate targets. There were three different target patterns and each was presented with its own corresponding color. That is, each target pattern was associated with its own unique color. See Figures 1-3.

Although the orientation of each pattern differed depending on the patterns’ color, the sequence for clicking the targets was identical for each pattern. For example, target 1 was initially illuminated, followed by target 2, and so on until target 8 was illuminated. Each pattern followed the same sequence with targets 3, 5, and 7 being spatially
redundant, as were targets 1, and 8 (see Figures 1 – 3). In addition, the target did not advance to the subsequent target in the sequence until it was accurately clicked upon. That is, the mouse arrow had to be directly over the target for the computer to respond to the click. Finally, when a target was accurately “clicked” upon, a line appeared from the location of the previous clicked target thereby yielding a graphical “history” of the mouse clicks.

Each target had a diameter of 260 pixels. Using Paul Fitts’ index of difficulty equation, the index of difficulty between targets 1 and 2, and between target 7 and 8 was 4.53 calculated as being \( \text{ID} = \log_2 \left( \frac{2A}{W} \right) \) (Fitts, 1954). From Fitts’ equation, “A” was the distance between the targets and “W” was the width of the targets. Likewise, the index of difficulty between targets 2 and 3, 3 and 4, 5 and 6, and between targets 6 and 7 was 5.53.

During the acquisition phase participants were presented with both the target pattern and the color. The acquisition phase included a total of 36 trials, with each of the three patterns and corresponding colors presented 12 times each. Participants were presented with the target pattern and manipulated the computer mouse to click on each target of the pattern. The random practice schedule group was presented with the patterns in a random order. The same target pattern was never presented in 2 consecutive trials. The blocked practice schedule group was presented with the patterns in a blocked order. All trials of the first condition were completed before moving on to the trials of the second condition, and all trials of the second condition were completed before the trials of the third condition were presented. Participants were given a 10-minute break after completion of all acquisition trials.
During the retention phase, participants were presented with the target pattern but were not given the cues in the order to be clicked. In addition, once a target was accurately clicked, a line appeared denoting the history of clicks for the current trial. All cues were presented simultaneously and the participant had to click the cues in the correct target pattern. Both groups completed the same order of trials and 2 trials of each condition.

**Statistical Analysis and Research Design**

*Research Design*

This two-phase experiment used an acquisition and a retention phase. As mentioned above, participants were randomly assigned to either the Random or the Blocked groups. All participants learned three different patterns during the acquisition phase and were required to recall these patterns during the retention phase. Each of the three patterns required eight trials or ‘clicks’ of the mouse to complete one pattern. In the acquisition phase, each pattern was completed 12 times for a total of 288 mouse trials (mouse clicks). Likewise, the patterns in the retention phase required the same 8 trials (mouse clicks) to complete. Each pattern was introduced 3 times for a total 72 trials for the retention phase. The trials were numbered sequentially from the acquisition phase to the retention phase, for instance, the trials ranged from 1 to 288 in the acquisition phase and from 289 to 360 in the retention phase.

*Acquisition Phase*

For reaction time, trials 1, 96, 97, 192, 193, and 288 were averaged together within each condition (i.e., blocked and random conditions) for a total of 6 mean reaction time scores. Trials 1, 97, and 193 represent the first trials of a new pattern that the
blocked group experienced; whereas trials 96, 192, and 288 represent the last trials of each pattern that the blocked group experienced. Movement time was calculated as the time it took to complete patterns within trials 1 – 8, 56 – 64, 112 – 120, 168 – 176, 224 – 232, and 280 – 288. These were summed into 6 mean movement time values. These blocks of trials were chosen because they are evenly dispersed throughout the acquisition phase. Separate 2 x 6 (group x trial) analyses of variance (ANOVA) with the factor of trial being repeated were used to analyze the difference between groups during the acquisition phase for the movement time and reaction time.

*Retention Phase*

For reaction time, trials 289, 312, 313, 336, 337, and 360 were averaged together within each condition (i.e., blocked and random conditions) for a total of 6 mean reaction time scores. Trials 289, 313, and 337 represent the first trials of each new pattern that each participant experienced. Trials 312, 336, and 360 represent the last trials of each pattern that each participant experienced. Movement time was calculated as the time it took to complete patterns within trials 289 – 297, 313 – 321, and 337 – 345. These were summed into 3 mean movement time values. These blocks of trials were chosen because they are evenly dispersed throughout the retention phase. Separate 2 x 3 (group x trial) ANOVAs with the factor of trial being repeated were used to analyze the difference between groups during the retention phase for the movement time and reaction time.

*Results*

Although 14 participants were recruited for this study, data from one participant was not included in the analyses because of the participant’s inability to complete the
task. The participant was unable to control the mouse used to click on each target secondary to poor muscle control.

**Acquisition Phase**

The first hypothesis that there would be a difference between the blocked groups and random groups performance during the acquisition phase was not supported. No significant difference was found between the random group and blocked group for reaction time or movement time (see Table 1). However, descriptive statistics show that the reaction time means for the random group were higher than the blocked groups reaction time means for all trials analyzed except for trial 97 (see Figure 4). A significant difference was found for the factor of trial within each group regarding reaction time (see Table 1). Therefore, reaction times improved for all participants across trials.

Although not statistically significant, movement time means were also higher in the random group for each analyzed block of trials (total pattern of 8 clicks) than the blocked groups movement time required during the acquisition phase (see Figure 5). Participants in the random group required more time to complete each block of trials (total pattern of 8 clicks) than the participants in the blocked group.

**Retention Phase**

The second hypothesis, that there would not be a difference between the blocked groups and random groups performance during the retention phase, was supported (see Table 1). The reaction time means for each trial for the blocked groups performance was slightly higher than the random groups performance (see Figure 6) during each trial. A significant difference was found for the factor of trial within each group regarding
reaction time during the retention phase (see Table 1). Reaction times improved during
the retention phase for all of the participants across trials. Additionally, movement time
means for the random group’s performance during the retention phase was higher than
the movement time means for the blocked group (see Figure 7). The random group
required more time to complete each block of trials (total pattern of 8 clicks) than the
blocked group.

Discussion

Results of this study did not support the first hypothesis which stated that there
would be a difference between the blocked groups and random groups performance
during the acquisition phase. These findings are consistent with Luce and Rice (2004) in
terms of reaction time and movement time. The results indicate that the type of practice
schedule did not yield a difference in performance during the acquisition phase.

This is inconsistent with the findings of studies that have been conducted on
“normal” healthy populations, which have suggested that learning is facilitated in a
blocked practice schedule rather than in a random practice schedule during this phase
(Del Ray, 1989; Del Rey, Wughalter, Whittehurst, & Barnwell, 1983; Jarus, Wughalter,
& Gianutsos, 1997; Lee & Magill, 1983; Wood & Ging, 1991). For example, Shea and
Morgan (1979) found that during the acquisition phase of learning a simple movement
pattern the blocked practice schedule group performed better than the random practice
schedule group. Del Ray et al. (1983) also found similar results during the acquisition
phase in a healthy population performing a coincidence timing task. Similarly, Lee and
Magill (1983) found that during the acquisition phase of learning a motor task similar to
the one used by Shea and Morgan (1979) healthy college aged adult’s performance was
facilitated in the blocked practice schedule group in comparison to the random practice schedule group’s performance. Del Ray (1989) found that in a healthy population the blocked practice schedule group outperformed the random practice schedule group during the acquisition phase in learning a sports related task. Wood and Ging (1991) also studied college students and found similar results in a simple motor task. Jarus, Wughlater, and Gianutsos (1997) also found that the blocked group’s performance was facilitated during a task that involved tracking a target with head movements when compared to the random practice group’s performance. These studies were all conducted on normal healthy populations. The findings of these previous studies are inconsistent with the findings of the present study conducted on individuals with a traumatic brain injury.

The results support the second hypothesis, which stated that there would not be a difference between groups during the retention phase. Reaction time and movement time did not yield a significant difference regardless of type of practice schedule during the retention phase. These results are consistent with the findings of Heitman and Gilley (1989) and Luce and Rice (2004) in which a significant difference between the two groups was not found during the retention phase within special populations. The findings of Heitman and Gilley (1989) and Luce and Rice (2004) suggest that within these populations (e.g. persons with traumatic brain injury and persons with mental retardation) the type of practice schedule does not effect the ability to recall previously learned information.

Within this study, it is important to note that during both the acquisition phase and the retention phase significant results were found across trials in regards to reaction time.
Regardless of the type of practice schedule, reaction times improved with each consecutive trial. These findings suggest that performance improved as the participants had more experience with the task and perhaps became more familiar with the task. This is also important when considering one of the studies limitations, which is that the study did not control for level of computer experience that each participant had prior to the completion of the task. Although, some participants had more experience with using a computer than others, their ability to improve reaction time demonstrated that they were able to learn and improve their performance with using a computer mouse.

In regards to the blocked group, it is important to note that Figure 4 indicates continued learning from the initial trial pattern to the last trial pattern. In other words, the time in milliseconds from trials 1-96, 97-192, and 193-288 all decrease for the blocked group indicating that within each pattern learning took place from the first attempt to the last attempt. Additionally, qualitatively the slope within each successive pattern becomes more shallow indicating that with each successive pattern the task became easier for the participants to learn (there was some carryover learning from the previous pattern). Figure 5 suggests that qualitatively, the random group was still learning from the first to the final trial within each pattern.

This study suggests that the degree of contextual interference does not have an effect on persons with traumatic brain injury compared to ‘normal’ healthy populations when considering the general consensus of studies performed with ‘normal’ populations (Del Ray, 1989; Del Rey, Wughalter, Whittehurst, & Barnwell, 1983; Jarus, Wughalter, & Gianutsos, 1997; Lee & Magill, 1983; Shea & Morgan, 1979; Wood & Ging, 1991). In order to teach motor skills to clients, occupational therapy practitioners must consider the
most optimal practice schedule to present their clients in therapy. These clients are not the ‘normal’ populations of past motor learning research. Occupational therapy clients have physical, social, and/or cognitive disabilities. During a random practice schedule a higher level of cognitive processing is required (Shea and Zimny, 1983). Those who suffered a traumatic brain injury may lack the higher level of cognitive processing that is required to learn a motor task presented in a random order. Although both groups showed improvement across trials, no difference was found between groups in terms of reaction time and movement time. Perhaps the level of complexity of the computer task required a greater level of cognitive process for both the random and blocked group. Where as in past studies conducted on healthy populations, only the random group required the high level of cognitive processing. The higher level of cognitive processing required to complete the task for both groups in the current study may have been so great that no difference in performance between groups was found. Therefore, contextual interference may or may not be an effective motor learning strategy for this population, especially if the task requires a higher level of cognitive processing. The findings of the current study along with Luce and Rice (2004) and Heitman and Gilley (1989) suggest that when presenting a motor task to a client in occupational therapy a high contextual interference practice schedule may not be the most optimal way to present the task.

There are several limitations to this study. Clearly, one limitation to the study is the small sample size. As with many special populations, the variability within this study’s participants, was high. As such, it is often difficult to avoid Type II errors with such a small n. Another limitation is that the task itself may have proven to be too mundane or ‘boring’ for the participants. Additionally, the time demands for each
participant was approximately 45 minutes. This may have exceeded the participants’
ability to stay on task. Figure 4 suggests that most of the learning occurred during the
first 96 trials of the task. It is suggested that future studies using this computer program
should involve fewer trials of each task. This would reduce the time demands on each
participant.

Many times the researcher had to intervene and explain the task or redirect the
participant to the task between trials. Therefore, it is possible that the task was too
difficult for the participants. Additionally, in regards to the computer program, the size of
the target was difficult for some of the participants to accurately click due to problems
with controlling the mouse. Lastly, the overall complexity of the task could have effected
the results of this study. Using the computer mouse alone was a challenge for some of
the participants of this study. If a participant did not have experience working with a
computer, he or she may have had more anxiety while using the computer or spent more
effort into trying to learn how to use the computer mouse than to learn each pattern of the
task.

This study suggests that contextual interference may not be an effective strategy
for motor learning within the traumatic brain injured population. Generalizing this
conclusion must be done with great conservation due to the small sample size as well as
its varied corroborations with the results of previous studies. In order to utilize the most
effective practice schedule in occupational therapy, further research needs to be
conducted in the area of contextual interference. Suggestions include controlling for task
complexity and/or meaning ascribed to the task. Further investigation of movement time
and reaction time using different types of tasks (especially those involving occupationally
embedded exercises) involving special populations is needed. With additional studies, occupational therapists may have more confidence in providing the appropriate practice schedule to clients in therapy.

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References


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Figure 1. Target pattern for “red” condition.
Note: The targets have been numbered for this figure but do not appear in the actual display.
Figure 2. Target pattern for “blue” condition.
Note: The targets have been numbered for this figure but do not appear in the actual display.
Figure 3. Target pattern for “green” condition.
Note: The targets have been numbered for this figure but do not appear in the actual display.
Figure 4. Mean reaction time and standard deviation for the blocked group and random group during the acquisition phase.
Figure 5. Mean movement time for the blocked group and random group during the acquisition phase.
Figure 6. Mean reaction time and standard deviation for the blocked group and random group during the retention phase.
Figure 7. Mean movement time and standard deviation for the blocked group and random group during the retention phase.
Table 1. Analyses of variance during the acquisition and retention phases for reaction time and movement time

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## Disability Rating Scale

**Appendix.** Disability Rating Scale

<table>
<thead>
<tr>
<th>Category</th>
<th>Item</th>
<th>Instructions</th>
<th>Score</th>
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<tbody>
<tr>
<td><strong>Arousalability, Awareness and Responsivity</strong></td>
<td>Eye Opening</td>
<td>0 = spontaneous  1 = to speech  2 = to pain  3 = none</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communication Ability</td>
<td>0 = oriented  1 = confused  2 = inappropriate  3 = incomprehensible  4 = none</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Motor Response</td>
<td>0 = obeying  1 = localizing  2 = withdrawing  3 = flexing  4 = extending  5 = none</td>
<td></td>
</tr>
<tr>
<td><strong>Cognitive Ability for Self Care Activities</strong></td>
<td>Feeding</td>
<td>0 = complete  1 = partial  2 = minimal  3 = none</td>
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</tr>
<tr>
<td></td>
<td>Toileting</td>
<td>0 = complete  1 = partial  2 = minimal  3 = none</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grooming</td>
<td>0 = complete  1 = partial  2 = minimal  3 = none</td>
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<tr>
<td><strong>Dependence on Others</strong></td>
<td>Level of Functioning</td>
<td>0 = completely independent  1 = independent in special environment  2 = mildly dependent  3 = moderately dependent  4 = markedly dependent  5 = totally dependent</td>
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<tr>
<td><strong>Psychosocial Adaptnility</strong></td>
<td>Employability</td>
<td>0 = not restricted  1 = selected jobs  2 = sheltered workshop (non-competitive)  3 = not employable</td>
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### Disability Categories

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<tr>
<th>Total DR Score</th>
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<td>Partial</td>
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<td>Severe</td>
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<td>Extremely Severe</td>
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<td>22-24</td>
<td>Vegetative State</td>
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<tr>
<td>25-29</td>
<td>Extreme Vegetative State</td>
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