Differences in attention, hand dexterity, and lower extremity activities in the presence or absence of a time limit

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Abstract. [Purpose] The purpose of this study was to investigate how a time limit affects day-to-day tasks such as attention, hand dexterity, and sit to standing and sitting activity. The grounds for using a time limit as a method of learning tasks related to daily living are examined based on the results of this investigation. [Subjects and Methods] The subjects consisted of 51 healthy college students (20 males and 31 females). The task performance time for SESSION 1, in which there was no time limit, was measured and the task duration privately recorded. The task performance for SESSION 2 was then measured with a time limit of the same duration as the time recorded for SESSION 1. Attention was measured using the trail-making test, hand dexterity using the Purdue pegboard test, and lower extremity activity using the sit to standing and sitting test. [Results] The levels for the attention, hand dexterity, and lower extremity activities were high in the environment in which a time limit was set. The differences between the genders depending on the presence or absence of a time limit was insignificant. [Conclusion] A time limit environment can be used as a task-training method for attention, hand dexterity, and lower extremity activities

Key words: Activity, Attention, Time limit

INTRODUCTION

Even when people are given the same amount of time for a task, how they use the same time resource varies for each individual argues that a time limit motivates task performance and helps people to perform tasks faster. In general, people seem to concentrate more and make a greater effort with tasks when a time limit is specified. It has also been found that time limits can contribute to positive role play in reading tasks. The ability to complete a task within a given time and the power to focus our mind on that task are referred to as attention. Attention influences mental and physical activities, and a higher level of attention is associated with greater exercise and task performance ability. If attention is lacking in the performance of a task, this generally means that people pay insufficient attention to detail, make mistakes, and cannot maintain concentration. As a result, they cannot complete their tasks within the deadline, cannot systematically perform task activities, and are easily distracted by external stimuli. There are a number of endogenous and exogenous factors that influence attention. The exogenous factors include the nature or characteristics of a task, social pressure, competition, and the auditory and visual stimuli of the task. The endogenous factors include physiological arousal level, personality characteristics, and neurological characteristics. In many stroke patients, problems of endogenous factors such as arousal level and nerve characteristics are revealed. This makes clinicians often suffer from post-stroke training.

A time limit refers to the performance of a task within a specified time and is also called “time pressure.” A constraint is generated when there is limited rather than infinite time available to complete a task. The sense of a time limit feels greater...
when the given time for completing the task is shorter, while the sense of a time limit feels smaller when the given time is longer. A time limit is particularly a factor in tasks that require many elements, including mental and physical activities. Tsukiyama T\(^9\) notes that, compared to unlimited time, limited time can improve concentration and brain power, which enables the efficient performance of tasks. A time limit method can be used to master tasks and also to improve concentration in daily living. In the physical therapy room, there are occasional time-limited exercises as a way to increase the concentration in the post-stroke rehabilitation phase. This study investigates the effects of a time limit on attention and activities in the performance of short tasks relating to daily living, such as those mentioned above.

For this purpose, the effects of a time limit on simple tasks, such as sit to standing and sitting, and pegboard handling with the hands, were examined to establish grounds for using a time limit as a rehabilitation training method for day-to-day tasks.

**SUBJECTS AND METHODS**

In this study, the effects of time limits on the performance of daily activities are examined. A blind test was applied to prevent the subjects from knowing the effects of the study results. This study design is one-group pretest-posttest research. The trail-making test, the Purdue pegboard test, and the sit to standing and sitting test were performed to investigate differences in sit to standing, sitting, and hand dexterity, all of which are performed frequently on a daily basis. This study was approved by the of Kangwon National University College Institutional Review Board (KWNUIRB-2015-06-006-001) and followed the ethical principles set forth in the Declaration of Helsinki.

Subjects were undergraduate students from the university in Korea, recruited through the school bulletin board. The study participants included 51 healthy college students (20 males and 31 females), whose average age was 20.1 for the males, 20.73 for the females, and 20.61 for all subjects. The average height was 1.74 m for the males, 1.61 m for the females, and 1.64 m for all subjects. The average weight was 64.2 kg for the males, 55.22 kg for the females, and 56.98 kg for all subjects. The purpose and method of the study were sufficiently explained to every subject, and the selected subjects were those who voluntarily agreed, had no diseases or functional problems in the upper or lower extremities, and had no damage to perception, visual perception, or hearing.

The trail-making test (TMT) was conducted to test attention, the Purdue pegboard test was conducted to test hand dexterity, and the sit to standing and sitting tests (SSST) were used to test muscle endurance. The tests were conducted randomly. Each test took about three minutes and all of the tests together took about 20 minutes. In SESSION I, every subject performed each task, and the time for each task was recorded. In SESSION II, a time limit was applied based on the time measured in SESSION I. The times recorded in SESSION I were withheld from the subjects so as not to influence SESSION II. The same environment and place were used for both SESSION I and SESSION II, and the tests were conducted quietly (Fig. 1).

In this study, divided attention was evaluated using the trail-making test (TMT). The TMT has two versions: In version A, numbers are scattered randomly and the subject is instructed to connect them by drawing lines sequentially from number 1. In version B, the subject is instructed to connect the numbers and alphabet letters alternately, for example, 1-A-2-B-3-C-4-D, by drawing lines\(^11\). The test method was to connect the numbers in circles, which were placed randomly, by drawing lines sequentially in ascending order. The subjects were instructed to connect the numbers sequentially as soon as possible without taking the pencil from the paper. The elapsed time was then measured. This is a reliable tool with a test-retest reliability of 0.87 and an intra-rater reliability of 0.99\(^12\). The above test was conducted using 24 A4-sized circles with 12 numbers and
The lower extremity activity was measured using the sit to standing and sitting test (SSST). For the SSST, the subjects sat on a chair with armrests on a flat floor, with both feet comfortably placed on the floor and the tips of the two feet in parallel. They then stood up with their knees spread and sat down on the chair again. This cycle was measured once. The SSST was performed on a chair with no wheels and with the subjects’ outer clothing removed. The chair was positioned against the wall so that it could not be pushed back. Before the first experiment, the tester told the subjects, “Time is unlimited, so keep going until you hear ‘Stop’.” The “Stop” signal was then given, and measuring started for the first experiment. The performance time was recorded by means of a timer. For the second experiment, the measured time of the first experiment was given as a time limit. The tester said, “I will give you 00 seconds to do this in the same way as you did in the first experiment.” Then the tester signaled “Start” to kick off the experiment and “Stop” to end it at the specified time. For score conversion, each correct connection was given one point and one point was subtracted for each error. The highest score was 10 if the subject made no error in the first experiment.

The Purdue pegboard test (PPT) is used to investigate dexterity in hand manipulation ability. The PPT was developed by Joseph Tiffin from Purdue University in 1948 in order to select employees at industrial sites. This tool evaluates the hand dexterity required to perform organizational tasks. The subject inserts pins, colors, and washers into a wooden board. To test the right hand, left hand, and both hands, the subject inserts pins for 30 seconds, and for the assembly task, the subject assembles for 60 seconds. In this case, the test-retest reliability of the PPT was between 0.90 and 0.76 for one attempt, and between 0.82 to 0.91 for three attempts, which were high values.13

With the subjects sitting at a table, the tester asked them what their dominant hand was and gave a demonstration, along with an explanation. The experiment started after two practices. Before the first experiment, the tester said, “Pick one pin at once and do not concern yourself even if you drop a pin. Keep doing until you hear “Stop”.” The tester then gave the “Start” signal and began measuring for the first experiment. The subjects were instructed to stop once they had inserted 15 pins, and the time was recorded but not made known to the subjects. For the second experiment, the measured time of the first experiment was given as a time limit. The tester said, “I will give you 00 seconds to do this in the same way as you did in the first experiment.” Then the tester signaled “Start” to kick off the experiment and “Stop” to end it at the specified time. For score conversion, each correct connection was given one point and one point was subtracted for each error. The highest score was 10 if the subject made no error in the first experiment.

In this study, the effects of a time limit on the activities of daily living were investigated. Specifically, in SESSION I, attention was measured based on the time it took for the subject to reach E in the TMT, while hand dexterity was measured based on the time it took to move 15 Purdue pegboards. In terms of lower extremity activity, the time it took to perform 20 sit to standing and sitting cycles was measured. Subsequently, in SESSION II, the times measured in SESSION I were specified as a time limit against which the above task performance counts were measured.

The results according to the presence or absence of a time limit are outlined in Table 1. When no time limit was given, the
time to reach E in the TMT, or the time it took to acquire 10 points, was 26.20 ± 5.58 seconds. When 26.20 ± 5.58 seconds was given as the time limit, the average score was 11.53, and the difference was statistically significant (p<0.01). The fact that the score was higher when a time limit was applied means that attention increased during these tasks.

In the hand dexterity test, the average time it took to move 15 pegboards with no time limit was 28.22 ± 8.39 seconds. When 28.22 ± 8.39 was given as a time limit, the subjects moved 15.82 pegboards, and the difference was statistically significant (p<0.01). Therefore, hand dexterity improved in the time-limited situation, because the Purdue pegboards had to be moved subject to a time limit.

The average time it took to perform 20 cycles of SSST was 28.90 ± 4.73 seconds. When 28.90 ± 4.73 seconds was given as a time limit, the average cycle time increased to 24.22, and the difference was statistically significant (p<0.01). Hence, the lower extremity activity values increased when a time limit was given, as evidenced by the increased number of SSST cycles.

Therefore, attention, hand dexterity, and lower extremity activity all showed statistically significant differences, suggesting that a time limit influences the performance of daily activities.

The gender differences according to the presence or absence of a time limit are outlined in Table 2.

In SESSION I, which had no time limit, the male and female subjects were measured for the same number of cycles. In SESSION II, the gender differences in attention, hand dexterity, and lower extremity activity in the presence and absence of a time limit were examined. The results indicated that both males and females increased their average scores when a time limit was applied. However, the gender differences were not statistically significant. Therefore, there are no gender differences in terms of attention and day-to-day activities according to the presence or absence of a time limit.

### DISCUSSION

This study investigated the effects of a time limit during the performance of tasks such as TMT, sit to standing and pegboard activity. The grounds for using a time limit as a method of learning day-to-day tasks were examined through this experiment.

It has been observed that a time limit motivate task performance, leading people to concentrate more on tasks and make greater efforts to achieve them2). Furthermore, a time limit play a positive role in reading tasks, and performing tasks and reading are generally associated with attention3). According to Dember and Warm, the nature of attention is that it allows organisms to sideline unnecessary information in order to obtain other important information for themselves over a given time period, and to focus on the perception or awareness of specific stimuli to the exclusion of unnecessary stimuli4).

In a time-limited situation, people generally show three characteristics: Acceleration, filtration and adaptation. Acceleration, or processing information at a faster pace; filtration, or neglecting some information and processing only a subset of information that is perceived as the most important; and adaptation of different strategies or decision rules, or switching to a simpler strategy, for example, from an alternative-based to a less cognitively demanding, attribute-based processing strategy. The best strategy is to use a combination of acceleration and filtration. These three steps are hierarchical. In the acceleration step, people try to process tasks faster; in a more difficult situation, they filter information; and in the next step, they change to the simplification strategy5–18).

In this study, the subjects showed improvements in their attention, hand dexterity, and low extremity activity when a time limit condition was applied. This result is similar to a study reporting that the specification of a time limit achieved the highest level of attention in reading comprehension19). On the other hand, Kim20) reported that accuracy and writing levels were lower when there was a time limit compared to when there was no time limit. Park21) also claimed that a time limit had no effect on the creativity of individuals. These findings suggest that a time limit have a greater correlation with the achievement of quantitative tasks than qualitative tasks. The findings of this study point to the acceleration step, which appears first in a time limited situation. The tasks in the study were typical daily activities rather than creative or qualitative activities. Therefore, attention, hand dexterity, and lower extremity activity improved under a time limit condition.

A national study of physical strength in Korean people revealed that males showed much higher statistical results than females in exercises requiring muscle endurance, such as sit-ups and push-ups22) (Korea Institute of Sport Science, 2011). The variables that affect dexterity also show significant differences according to gender, with females showing greater dexterity.

| Table 2. Gender differences in the presence or absence of a time limit (N=51) |
|-----------------------------|-----------------------------|-----------------------------|
| Gender                      | SESSION I                  | SESSION II                 |
| Attention (point)           | Male 10 ± 0.0              | 11.7 ± 2.2                 |
|                             | Female 11.5 ± 2.3          | 11.5 ± 2.3                 |
| Hand dexterity (number)     | Male 15 ± 0.0              | 16.1 ± 1.7                 |
|                             | Female 15.8 ± 1.6          | 15.8 ± 1.6                 |
| Lower extremity activity (number) | Male 20 ± 0.0         | 25.0 ± 2.7                 |
|                             | Female 24.0 ± 4.2          | 24.0 ± 4.2                 |
than males in some studies\(^{22}\). In the current study, however, no gender differences were found. Meanwhile, Kim, Jung, and Kwon\(^{23}\) also found no significant differences in dexterity between males and females. In a study by Jung, Nam, and Kim\(^{24}\), males and females showed identical improvements when performing muscle endurance exercises. Thus, gender differences in physical strength appear to be different according to the measurement criteria. The reason for the results of the Jung et al. study seems to be that a time limit was short, at less than 30 seconds, and the goal of the measurement in the study was the maximum physical strength rather than the maximum physical strength or activities of the adults.

In the current study, attention, hand dexterity, and lower extremity activity were measured in a time limit situation. The tasks in the study were simple and ordinary, and the subjects showed improvements in their attention, hand dexterity, and lower extremity activity in a time limit situation. However, it is unclear how the results of this study would be affected if the subjects had been performing, accuracy, or complex tasks. Therefore, further studies on the performance of tasks with a higher difficulty level in a time limit situation are required in the future.

This study aimed to investigate the effects of a time limit on the attention, hand dexterity, and lower extremity activity of healthy adults in their twenties. The subjects showed improvements in their attention, hand dexterity, and lower extremity activity in a time limit situation. However, no gender differences were found. Therefore, the findings indicate that a time limit could be imposed as a training method for attention, hand dexterity, and lower extremity activity tasks.

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