A Comparison of Performance in Added-Purpose Occupations and Rote Exercise for Dynamic Standing Balance in Persons With Hemiplegia

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Key Words: human activities and occupations • motivation

Objectives. Adding purpose to daily occupations to promote performance is a basic premise of occupational therapy. This study investigated the hypothesis that in persons with hemiplegia, two added-purpose occupations would elicit more exercise repetitions than a rote exercise.

Method. In a counterbalanced order, 21 subjects with hemiplegia, aged 51 to 78 years, experienced all three conditions of a dynamic standing balance exercise that involved bending down, reaching, standing up, and extending the arm. One condition of added purpose involved the use of materials (small balls and target); a second added-purpose condition involved the subjects' imagination of the small balls. The third condition was the rote exercise without added purpose.

Results. A one-way analysis of variance for related measures indicated that the subjects performed significantly differently in each of the three conditions (p < .001). A Tukey multiple comparison test revealed that the subjects did significantly more exercise repetitions in the added-materials condition and in the imagery-based condition than in the rote exercise condition (p < .05).

Conclusion. This study demonstrates how added purpose can enhance motor performance in persons with hemiplegia. Purpose may be effectively added to an exercise through the use of materials or imagery.

Occupational therapy is based on the belief that purposeful activity (occupation), including its human and nonhuman aspects, may be used to mediate dysfunction and elicit maximum adaptation (Hopkins & Smith, 1983). Furthermore, added-purpose occupation may be used in the clinic for patients to learn new skills (Gliner, 1985).

Literature Review

Added-Purpose Occupation

It has been argued that added-purpose occupations may improve exercise performance. Several studies have investigated how added-purpose occupations promote movement and performance (Bloch, Smith, & Nelson, 1989; Heck, 1988; Kircher, 1984; Lang, Nelson, & Bush, 1992; Licht & Nelson, 1990; Miller & Nelson, 1987; Morton, Barnett, & Hale, 1992; Mullins, Nelson, & Smith, 1987; Riccio, Nelson, & Bush, 1990; Steinbeck, 1986; Thibodeaux & Ludwig, 1988; Yoder, Nelson, & Smith, 1989; Yuen, 1988). The concept has been examined in empirical studies in which the performance of subjects participating in added-purpose and non-added-purpose occupations was compared.

For example, Kircher (1984) studied the effects of jumping rope (added-purpose activity) and jumping in
place without a rope (rote exercise) on the heart rate and duration of exercise for 26 women. Results showed that heart rate increase upon stopping at a predetermined level of perceived exertion was higher for jumping rope than for jumping in place. However, no notable difference in the subjects’ exercise duration was found. On the basis of the findings that exertion and fatigue were perceived to be lower when involved in added-purpose occupation than in rote exercise, Kircher concluded that added-purpose occupation may have served as an intrinsic motivator for the subjects.

Yoder, Nelson, and Smith (1989) compared a rotary arm exercise with the added purpose of stirring cookie dough to a rotary arm exercise with no added purpose. They found that the added-purpose exercise elicited more exercise repetitions than did the non-added-purpose condition.

Licht and Nelson (1990) compared the effects of adding meaning through stimulus figures in a design copy task versus not adding meaning to the task. The added-meaning occupation elicited better performance (fewer errors) than the non-added-meaning occupation.

 Heck (1988) examined the difference between an added-purpose tracing task and non-added-purpose tracing task in terms of pain control. The subjects tolerated electrically induced pain longer while performing the added-purpose task.

Yuen (1988) demonstrated that subjects can learn to coordinate different muscle groups to control the movement of a prosthesis when joining dots. In Yuen’s study, the subjects in the experimental group were asked to join dots with the beam of a flashlight inserted into the terminal device of a prosthesis. The control group was asked to practice moving the forearm component of the prosthesis without any added materials (the flashlight beam) to provide visual cues. The results revealed that subjects in the experimental group (the added-materials occupation) traced better than the subjects in the control group. Yuen’s study suggests a new area for occupational therapists to explore that involves the purposeful use of materials in motor skills training. It also supports the theoretical suggestion that provision of added purpose can enhance motor skill development.

Imagery-Based Occupation

According to Nelson and Peterson (1989), occupation can be categorized as (a) naturalistic, (b) simulated, or (c) imagery based. As Nelson (1988) pointed out, naturalistic and simulated occupations usually involve materials or props, whereas imagery-based occupations, elicited by verbal or pictorial stimuli, usually involve no materials.

A different line of research has emphasized the importance of mental imagery in the development of motor skills. Imagery is an internal psychological process involving the evocation of the physical characteristics of objects or events that are absent from the perceptual field (Denis, 1985). Practitioners in the fields of physical education, psychology, and movement science often use imagery as mental practice for the sake of learning or enhancing a new motor skill. Richardson (1967) stated that mental practice, the practice of physical activity with mental images, is the tool most investigators use to make a person’s latent movement potential greater. Fansler, Poff, and Shepard (1985) compared the effects of three intervention conditions on subjects’ one-legged balance time. The three conditions included (a) mental practice of the physical task, (b) progressive relaxation, and (c) distraction of the subjects’ attention with meaningless instructions (control condition). Contrary to expectation, improvement in the subjects’ performance after completing the mental practice condition was not notably greater than their performance after the other two conditions. Fansler et al. believed that the results were affected by the subjects’ individuality (e.g., having different mental images) and the small sample size. However, they argued that mental practice of a physical task can improve performance and may be useful in the rehabilitation of elderly persons.

Clinicians have used imagery to motivate patients to engage in repetitive exercise patterns. Riccio et al. (1990) investigated the effects of verbally elicited imagery with elderly women through the use of two exercises—reaching up to pick apples and reaching down to pick up coins. The results indicated that the imagery condition elicited significantly more repetitions of the reaching-up exercise than did the control condition of the exercise without imagery ($p = .012$). The results in the reaching-down exercises were generally in the same direction ($p = .055$). This study represents a beginning step in considering the potential use of imagery in occupational therapy. It also introduces a way to enhance purposefulness and occupational performance without the use of physical materials.

Lang et al. (1992) investigated the performance of 15 elderly persons in two added-purpose occupations (kicking a balloon and imagining kicking a balloon) and a controlled rote exercise. They found that the subjects performed a greater number of repetitions when kicking the balloon than in the imagery-based occupation and rote exercise. However, the subjects’ performance in the imagery-based occupation and rote exercise was not significantly different from one another. The authors argued that a larger sample might show the expected results.

The results of research studying the effects of added-purpose occupations, above all the imagery-based ones, in enhancing performance seems to be inconclusive. Furthermore, the subjects studied were residents of nursing, retirement, and foster care homes or young adults without impairments. The samples did not include most categories of patients (e.g., patients with hemiplegia) treated by occupational therapists in clinics. Therefore, the ex-
We predicted that the subjects would perform better in the added-purpose occupations for dynamic standing balance in patients with hemiplegia. The success of the functional ambulation training may depend on the development of dynamic standing balance. Restoring safe standing leads to the development of a normal gait pattern (Brunnstrom, 1970). The task of dynamic standing balance depends on postural control (e.g., weight bearing and weight shifting of lower extremities). In addition, as Bobath (1978) asserted, the most effective method for normalizing muscle tone is through weight bearing exercise over the hemiplegic side.

Therefore, activities in which patients need to shift their weight to the hemiplegic side while standing could be used for dynamic standing balance training and for preambulation training. To encourage patients to move weight over the hemiplegic side, occupational therapists in Taiwan frequently use an activity in which bean bags are put on the floor on the patient’s impaired side. The patient then uses his or her unimpaired hand to pick up a bean bag from the ground, stand up, and throw it at a target. A patient engaged in this occupation needs to shift his or her weight over the hemiplegic side. This occupation may help inhibit abnormal muscle tone and should theoretically contribute to dynamic standing balance.

The purpose of this study was to investigate whether added-purpose occupations result in better performance than non-added-purpose occupations. We studied the differences among two added-purpose occupations (added-materials and imagery-based) and a control condition (rote exercise) for dynamic standing balance in terms of exercise repetitions by subjects with hemiplegia. We predicted that the subjects would perform better in the two added-purpose occupations than in the rote exercise.

Method

Subjects

Subjects who met the following criteria were selected from the Veterans General Hospital in Taipei, Taiwan: (a) they had received a diagnosis of unilateral cerebral hemiplegia, (b) they experienced a first or second onset of cerebrovascular accident (CVA) within 6 months before this study, (c) they were at least 50 years of age, and (d) they could follow and interpret verbal instructions, including responding to an imagery-eliciting cue—“Bend down and imagine using your unaffected hand to pick up a pebble from the ground and throw it forward.”

Twenty-one subjects were selected (12 men and 9 women). Their ages ranged from 51 to 78 years, with a mean age of 64.5 years (SD = 8.9). Fourteen subjects had experienced a first onset of CVA and 7 a second onset. The duration from the most recent onset until data collection ranged from 23 days to 176 days, with a mean duration of 81.6 days (SD = 46.5). The sample consisted of 7 subjects with left hemiplegia and 14 with right hemiplegia. The period of data collection was 69 days.

The Brunnstrom (1970) upper and lower extremity recovery stages for hemiplegia were used to describe the physical dysfunction of these subjects. Brunnstrom defined six stages of arm and lower extremity recovery of hemiplegia as follows: (a) flaccidity (no voluntary movement); (b) developing synergies, spasticity, or both; (c) synergies performed voluntarily; (d) synergy deviation; (e) independence from the basic synergies; and (f) isolated joint movements freely performed with near-normal coordination. Each subject’s impaired upper and lower extremity was evaluated separately. Brunnstrom’s upper extremity stage for the 21 subjects ranged from 2 to 6, with a mean stage of 3.9 (SD = 1.0); the lower extremity stage was from 3 to 6, with a mean stage of 4.4 (SD = .8).

Conditions and Apparatus

The added-materials occupation involved the throwing of small balls. The subject bends down, uses his or her unimpaired hand to pick up a small ball from the ground, stands up, and throws it at the target. Small balls were used instead of the bean bags often used in Taiwanese hospitals to provide a more familiar image in the imagery-based condition. For the imagery-based occupation, the subjects imagined using their unimpaired hand to pick up a small ball from the ground and throw it to the target. The rote exercise was the control condition in which the subjects just did the physical exercise (touching the ground with their unimpaired hand, standing up, elevating the arm, flexing the elbow, and stretching the arm forward quickly). The same basic physical exercise was performed in each condition.

A rectangular board (135 cm x 100 cm) with a cutout face (eyes, nose, and mouth) was used as the target for the added-materials and imagery-based occupations. The small plastic balls used to throw at the target were 5 cm in diameter and weighed 6 g.

Procedure

After obtaining informed consent, each subject completed within a week all three conditions once, at the same time of day, in the same place. The subjects were not informed of the purpose and measurements of this study, nor were the occupational therapist and two research assistants (one who set up the experiment and a second who acted as interobserver). The subjects were randomly and equally assigned to three different orders in accordance with a counterbalanced design. In Order 1 (n = 7),
the subjects performed the added-materials condition first, the imaging condition second, and the control condition last. In Order 2 \((n = 7)\), the subjects performed the imaging condition first, the control condition second, and the added-materials condition last. In Order 3 \((n = 7)\), the subjects performed the control condition first, the added-materials condition second, and the imaging condition last. Each subject was involved in data collection sessions for each condition on different days, with approximately equal intervals between sessions. The sessions were conducted by an occupational therapist.

In the added-materials condition, the target was placed about 4 m in front of the subject. A research assistant, who stood behind the subject, placed the small balls on the ground near the subject’s unimpaired leg. The subject was given standardized instructions for performing each condition.

After the instructions were given, the occupational therapist sat about 6 ft away facing the subject. If a subject asked when he or she could stop or how many exercises he or she should do, the occupational therapist replied, “Try your best; stop when you are too tired.” If a subject ceased repeating the performance or took a rest for 5 sec (a discontinuity), the occupational therapist would ask him or her to do more exercise and add, “You can stop when you are too tired.”

Measurement
The frequency and duration of exercise repetitions and the frequency of discontinuities that lasted at least 5 sec were measured with a stopwatch and two counters. The stopwatch and counters were kept out of the subject’s sight and were silent. A repetition was a completed cycle of bending down, reaching the hand within 5 cm of the floor, standing up, raising the arm, flexing the elbow, and extending the arm forward quickly.

To establish interobserver reliability with the occupational therapist, the second research assistant randomly selected and independently measured one third of the sessions. Interobserver reliability was calculated by dividing the smaller frequency by the larger frequency and multiplying by 100. The interobserver reliabilities were 98.62% for frequency, 97.21% for duration, and 100% for discontinuity.

Data Analysis
Possible order effects among the three sessions of each condition were investigated through a one-way analysis of variance (ANOVA). A one-way ANOVA for a within-subject design was performed to find differences among the three conditions. The significant F ratios were subjected to a post hoc Tukey multiple comparison test to locate the differences among the conditions (Stevens, 1986). The results were considered to be significant at the .05 level of confidence.

Results
Preliminary testing indicated that skewness of the frequency variable under each of the three conditions was less than an absolute value of 1. The frequency variable was then treated as an interval variable. There was no significant order effect. The performance of the subjects in different sessions of each condition was not significantly different.

The one-way ANOVA for related measures demonstrated that there was a significant difference among the three conditions \((F(2,40) = 16.8, p < .001)\) (see Table 1). The Tukey multiple comparison test revealed that the subjects performed many more repetitions in the added-materials and imagery-based occupations than in the rote exercise at the .05 level. The difference between the added-materials occupation and the imagery-based occupation was not significant \((p > .05)\).

Most of the subjects had no discontinuities, and the range of distribution in this variable was small (0–2). The duration data were not analyzed statistically because of their interrelatedness with the frequency variable.

Discussion
The results of this study indicate that under certain conditions, the adding of purpose to therapeutic occupations can elicit superior performance. These results support a basic principle of occupational therapy, that added purpose should be embedded into occupations. Some studies (e.g., Yoder et al., 1989; Riccio et al., 1990) have reported that added purpose has a positive effect on exercise in certain populations. The outcome of our study is consistent with these studies and extends the ideas to an exercise pattern used for treating patients with hemiplegia. Our study also demonstrates that the effect of the added-materials occupation and the imagery-based occupation on eliciting performance is not significantly different. This result was not found by Lang et al. (1992).

Table 1
Comparison of the Performances for the Added-Materials Occupation, Imagery-Based Occupation, and Rote Exercise

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Added Materials</th>
<th>Imagery Based</th>
<th>Rote Exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of repetitions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(M)</td>
<td>23.86*</td>
<td>25.57*</td>
<td>17.29</td>
</tr>
<tr>
<td>(SD)</td>
<td>9.55</td>
<td>8.26</td>
<td>5.91</td>
</tr>
<tr>
<td>Duration (in sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(M)</td>
<td>166.62</td>
<td>159.71</td>
<td>116.86</td>
</tr>
<tr>
<td>(SD)</td>
<td>72.75</td>
<td>62.97</td>
<td>47.44</td>
</tr>
<tr>
<td>Frequency of discontinuities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(M)</td>
<td>.62</td>
<td>.62</td>
<td>.57</td>
</tr>
<tr>
<td>(SD)</td>
<td>.74</td>
<td>.81</td>
<td>.75</td>
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*Significantly greater at the .05 level than the rote exercise.
According to Kottke, Halpern, and Easton (1978), the coordination of multimuscular activities is not achieved by conscious motor control. In the added-purpose occupations, the subjects used or imagined their unimpaired hand picking up and throwing the small ball at the target. In contrast, through the rote exercise, the subjects completed the same physical pattern of exercise without having an added purpose. In the added-purpose occupations, the added materials and imagery transferred the subjects’ conscious attention from exercise to purpose and satisfaction so that they did not concentrate on the movement itself. Therefore, multimuscular coordination is completed more easily when there is added-purpose.

This study’s findings support the idea that added-purpose occupations can serve as intrinsic motivators to promote performance. Patients are able to use added-purpose occupations as intrinsic motivators to influence their physical and mental health and their social and physical environment (Hopkins & Smith, 1983). In a study by Thibodeaux and Ludwig (1988), subjects reported more enjoyment in the added-purpose condition than in the non-added-purpose condition. In the present study, one subject said, “I gained achievement from throwing the small ball as I could.” Another subject commented, “I imagined I was a pitcher and threw as many baseballs as I could.” This satisfaction is a key property of intrinsic motivation for sustaining and promoting performance in a task.

**Advantages and Disadvantages**

The findings of this study specifically support the use of adding materials to therapeutic occupations. According to Nelson and Peterson (1989), an added-materials occupation offers the following advantages: (a) it provides additional information to the person, which elicits and supports movement; (b) it often requires social prompts (e.g., competition, cooperation) to promote movement; (c) it can divert conscious attention away from the movement or the pain; and (d) the best rehabilitation results occur when the patient is able to combine exercise with the daily routine of occupations.

Nelson and Peterson (1989) also mentioned the possible disadvantages of the clinical use of added materials: (a) added materials may distract a person when conscious attention is needed; (b) added materials may cause a patient to remember a past experience and consequently lead to undesirable results (e.g., a person who used to be a pitcher might become depressed on seeing how poor his or her throwing has become); and (c) planning, staffing, use of space, and expenditure are all complex issues to consider when materials are used. Practitioners should be aware of these potential advantages and disadvantages and take individual needs and situations into consideration as they use added-materials occupations.

There were differences between the two added-purpose occupations. In the imagery-based occupation where the subjects imagined that they were picking up a small ball and throwing it at the target, the imagination helped the subjects to imagine throwing a ball. The results of (a) no significant difference between the added-materials occupation (use of balls) and the imagery-based occupation and (b) significantly more exercise repetitions elicited by the imagery-based occupation than by the rote exercise support and encourage therapy practitioners to use imagery-based occupations to promote performance.

According to Riccio et al. (1990), there are several advantages in the clinical use of imagery: (a) the therapy practitioner is not confined by materials; (b) imagery is more gradable (e.g., in terms of range) than physical materials; (c) imagery can be used in combination with standard equipment related to rote exercise (e.g., the jogging machine); and (d) imagery can communicate complicated events. For example, to obtain a specific movement, such as palmar pinch, the therapy practitioner instructing the patient to imagine picking up a baseball is more likely to be successful than the therapy practitioner describing the complex finger movements involved in performing that action. Riccio et al. asserted that imagery is involved with many developmental occupations, particularly occupations that depend on memories of past occupations.

On the other hand, the use of imagery in the clinic may have some disadvantages: (a) it might be difficult for some populations to experience mental images; (b) some movements are difficult or impossible to perform without materials (e.g., grasp); and (c) one patient’s image, memory, or both may differ from another’s on the basis of personal experience (Riccio et al., 1990). Therefore, the imagery cue given by the therapist practitioner might not result in the intended movements. However, the imagery-based occupation that is not limited by materials and space can sometimes serve the same therapeutic function as the added-materials occupation. Therefore, it may be more convenient for practitioners and patients to use the imagery-based occupation than the added-materials occupation in clinical intervention as well as home programs. Another possibility is a mixture of imagery and materials, as used in this study when the subjects were asked to throw imaginary balls at a real target.

**Variables**

Several variables existed in this study that were difficult to control. The first variable was the difference among patients in imagining the small ball. Each subject might have
had different images of the size, weight, shape, or color of the ball. Regardless of the type of ball the subjects imagined, this potential difference did not affect the results. In the imagery-based condition, the presence of materials might have represented a second difference. Use of the target in the imagery-based occupation might have promoted the subject’s imagery. Without a target, it is possible that the subjects might have perceived less purpose in the occupation. The presence of materials eliciting imagery-based occupations should be of concern to future researchers.

In the clinical setting, practitioners can adjust the distance from the target to maximize the patient's motivation to engage in the occupation. However, in this study the target was placed 4 meters in front of every subject, which might have represented a different level of challenge for each person. This difference might have affected the value of the added-material occupation as an intrinsic motivator.

As Nelson (1988) pointed out, the same occupation may have a great number of different meanings depending on the goal of the person, the environmental context, or the patient's mood. Furthermore, the patient may attach individual meanings to occupations or find no meaning at all. Therefore, it is vital for occupational therapy practitioners to investigate not only the difference among various kinds of added-purpose occupations and rote exercises, but also the differences among different types of added-purpose occupations. In controlled experimental research, few opportunities exist for individualization because everyone must follow the same procedure. In clinical practice, individualization, especially the variation from person to person in terms of occupational interests and meanings, is one of the most important criteria for occupational therapists to consider when choosing a specific therapeutic occupation. The chosen occupation should meet the patient's needs as well as promote his or her performance.

More studies that examine the differences among different added-purpose occupations to better understand how to maximize the patient's motivation and performance and to contribute to increasingly effective treatment are needed. Additionally, future studies should investigate various exercise qualities and patterns in different populations, especially in persons with hemiplegia. The study variables should include not only repetition and duration, but also range of motion, strength, coordination, and speed.

Summary

This study examined whether 21 subjects with hemiplegia performed more exercise repetitions in two added-purpose occupations than in a rote exercise. The results showed that the subjects did significantly more exercise repetitions in the added-purpose occupations than in the rote exercise, suggesting that purpose may be effectively added to an exercise through the use of actual materials or through the use of imagery. These results help to substantiate one of occupational therapy's basic tenets, that added-purpose occupation is a motivating factor in performance.

References


