Hand Strengthening With a Computer for Purposeful Activity

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Occupational therapists have traditionally chosen therapeutic activities that were of interest to patients. They have assumed that if patients enjoyed the activity, they would be motivated to sustain or increase performance (Florey, 1969). This approach embraces a model of intrinsic motivation, in which a key principle is the need to use pleasurable activities. Purposeful activities are defined as tasks in which the person actively participates and assists in directing the attention to the task rather than the processes required for achievement of the task (Hinojosa, Sabari, & Rosenfeld, 1983). Though purposeful activity need not be pleasurable, patient involvement is probably enhanced as intrinsic motivation is increased. Purposeful activity suggests involvement of both mental and physical faculties; this involvement correlates well with occupational therapy practice (Breines, 1984).

Kircher (1984) conducted a study that compared a purposeful activity (jumping rope) to a nonpurposeful activity (jumping in place). Jumping rope was considered to be purposeful in that the subject derived enjoyment from the skill competence as well as from manipulating and interacting with an object. The study demonstrated that, at a given rate of perceived exertion, heart rate was significantly higher in the performance of a purposeful versus a nonpurposeful activity. Steinbeck (1986) studied the number of repetitions completed by subjects engaged in purposeful versus nonpurposeful activities involving both the upper and lower extremities. At equal levels of exertion, results showed a significantly greater number of repetitions performed on the purposeful activities, thus supporting the hypothesis that persons will be motivated to perform longer when engaged in purposeful activity.

English (1975) suggested that computers could be used for therapeutic as well as administrative functions within an occupational therapy clinic. Later, Cromwell (1986) and Spicer and McMillan (1987) outlined specific therapeutic applications for computers within the field. King and Walsh (1990) reported results from a survey of all members of the American Society of Hand Therapists (n = 359) which showed that 82% had access to computers within their clinical practice. Only 3%, however, reported use of a computer for treatment activities other than when used in conjunction with a specific piece of equipment (e.g., BTE or Cybex).

Pashley (1989) reported the specific use of a computer as a purposeful activity in increasing hand strength. Pashley described the construction of a hand-strengthening device fashioned from two booster cable clamps that was connected to the joystick of an Apple IIe computer. This device was then used to operate commercially available software games that use the "open apple" and "closed apple" commands. In reporting results associated...
with the use of this adapted device, Pashley noted that patients tended to spend more time exercising while using the computer than with conventional spring-loaded grippers in noncomputer use but reported no specific data related to comparing number of repetitions. Pashley thought that the difference was due to the computer's more direct goal-oriented purpose.

This study was designed to add to Pashley's work by collecting data to determine whether the use of a computer game as purposeful activity would increase the number of repetitions by patients during grip and pinch strengthening activities.

Method

One hundred forty-six patients in a hand therapy clinic (84 males and 62 females), ranging in age from 16 to 78 years, volunteered to participate in the study. The only requirement for selection was that they be able to fully squeeze either the grippers or pinchers bilaterally.

Grip (see Figure 1) and pinch (see Figure 2) strengthening devices were constructed with contact points that were connected via cables to the serial port of an IBM-compatible computer. When the gripper or pincher was fully squeezed, contact between the two terminal points would be made and would send a signal to the computer. Two software programs were designed for the study, one purposeful and one nonpurposeful. The purposeful activity program consisted of a game in which missiles dropped from the top of the screen. A defense barrier at the bottom of the screen could be moved to the left or right with the gripper or pinch devices in an effort to block penetration of the missiles that fell randomly from different areas of the screen. This game lasted for 3 min and the program automatically kept count of the number of repetitions for squeezing the gripper or pincher in the right and left hands. The nonpurposeful activity program simply instructed the subject to exercise using the grippers or pinchers at a comfortable pace for 3 min. The program prompted the subject as to the amount of time remaining in the exercise session and also kept count of the number of repetitions for squeezing the gripper or pincher in the right and left hands.

Subjects were placed into one of two groups according to their treatment needs and abilities. One group used the grip strengthening devices bilaterally (n = 80) while the other group used the pinch strengthening devices bilaterally (n = 66). Subjects were not informed of the primary purpose of the study; they were told only that
new grip and pinch strengthening devices were being tested for use with a computer.

After being assigned to use either the grippers or pinchers, subjects were randomly placed in one of two groups. One group performed the purposeful activity first and then the nonpurposeful activity; the order of the activities was reversed for the other group. After completion of the two activities, the computer program then informed the therapist of the number of repetitions performed by the patient for the right and left hands during each activity.

Results
The means and standard deviations for the dependent variable of repetitions for purposeful and nonpurposeful activities with the grippers and pinchers are shown in Table 1. The number of repetitions for the right and left hands were summed for each of the activities.

Dependent t-tests indicated that the mean number of repetitions for the purposeful activity was significantly greater than for the nonpurposeful activity for both the grippers ($p < .001$) and the pinchers ($p < .05$).

Discussion
The use of purposeful activity in encouraging patient performance has been an inherent principle in the field of occupational therapy (Florey, 1969). The hypothesis that purposeful activity will increase patient performance in number of repetitions while using grip or pinch strengthening devices was supported by this study. This study confirmed Pashley's findings that computer games may be used effectively as purposeful activity for hand exercise. This study was limited in that the purposeful activity was determined for the subjects and was not of their specific choosing. Steinbeck (1986) raised the question of whether the patient's choice in determining a purposeful activity or the presence of an inherent goal is sufficient to provide increased motivation.

In this study it was documented for both gripper and pincher devices that the use of computer games may be a helpful tool in presenting goals to patients to increase number of repetitions during hand exercise activities. The exercise devices in this study may not be appropriate to all diagnostic categories (e.g., cumulative trauma disorder). Further research in this area would be helpful in determining additional uses of computers for treatment-related activities, such as dexterity or range of motion, as most clinics currently have access to computer hardware.

References


