Effect of Participation in a Cup Stacking Unit on Hand-Eye Coordination of Elementary Children

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Abstract

The purpose of this study was to empirically examine the influence of a cup stacking instructional unit on the hand-eye coordination of children. Participants (N = 104) consisted of three grade level groups (first/second, third and fourth). Within each grade level participants were randomly assigned to either an experimental or a control group. The experimental groups received a three-week instructional unit of cup stacking. The control groups received the standard physical education curriculum. All participants completed pretests and posttests on three tasks designed to measure hand-eye coordination. The results indicated significantly faster performance for older children than younger children for all three tasks. None of the tasks were statistically influenced by the cup stacking unit. Overall, the results of this study indicate that participation in a three-week instructional unit does not significantly improve hand-eye coordination in elementary age children.

Physical educators are continually in search of new activities to incorporate into their classes. Cup stacking is a relatively new activity that has been highly promoted at many of the state, regional and national conventions for physical educators. "In the exciting sport of cup stacking, students stack and unstack 12 specially designed plastic cups (*Speed Stacks*) in predetermined sequences and compete for time." (Speed Stacks, Inc., 2001) The promoters claim participation in this activity will result in many direct and indirect benefits, one of which is improved hand-eye coordination. Although there is much anecdotal support for these claims, limited empirical evidence exists (Udemann, Murray, Mayer, & Sagendorf, 2004).

According to the limited research on cup stacking, there is the potential for hand-eye coordination improvement by participation in cup stacking (Udermann et al., 2004). Udderman and colleagues showed a significant increase in both hand-eye coordination and reaction time in a group of second grade individuals that received training in cup stacking. These participants trained in cup stacking for 20 to 30 minutes per day, four days per week for five weeks. Although this training resulted in significant gains in hand-eye coordination, this type of training is not realistic in the regular physical education class.

There has been concern raised with regards to the level of moderate to vigorous physical activity associated with cup stacking, especially when practiced as in the Udderman et al. study (Baumgarten, 2004). One way to address the concerns of possible low levels of physical activity during cup stacking is to supplement cup stacking with fitness-oriented activities. Although improvement in hand-eye coordination has been found during intense training, the effect of an instructional unit of cup stacking supplemented with fitness activities on hand-eye coordination in elementary children has not been examined. Therefore, the purpose of the current study was to empirically examine the effect of a cup stacking instructional unit on the hand-eye coordination of children. If participation in an instructional unit of cup stacking does influence hand-eye coordination, the children with the exposure to cup stacking would exhibit improvement on the hand-eye

coordination tasks compared to the children who did not have exposure to cup stacking.

Methodology

Participants

Participants (N = 104) were children enrolled in combined first/second grades (N=39, 26 males, 13 females, age = 7.0 ± 0.7 years), third grade (N= 35, 13 males, 22 females, age = 8.7 ± 0.5 years), and fourth grade (N = 30, 19 males, 11 females, age = 9.5 ± 0.5 years) physical education classes at a laboratory school in a predominately middle class community in the Midwestern part of the United States. The majority of the participants were Caucasian (92%). None of the students had any experience with cup stacking. Within each grade level, one class of participants was randomly assigned to the experimental manipulation condition while another class was designated as the control condition. Consent for participation in the study was obtained from the child's parent or legal guardian in compliance with the University's Committee on the Use of Human Subjects in Research.

Tasks

Three hand-eye coordination tests were selected from the Bruininks-Oseretsky Test of Motor Proficiency (Bruiniks, 1978). Each participant completed three trials on each of the following tests, a one-handed penny test, a two-handed penny test and a pegboard test. The order of presentation of the tasks was randomized. Participants performed a one-handed penny task, which required the participants to place 24 pennies in a cup as quickly as possible using the non-dominant hand. Dominant hand was determined by asking the participant to write his/her name on a piece of paper. The hand used was listed as the dominant hand. The time to complete the trial was recorded for the three trials and the fastest time was recorded as the score. The participants also completed a two-handed penny task, in which they were instructed to place the pennies in the cups as quickly as possible using both hands. The time to complete the trial was recorded for the three trials and the fastest time was recorded as the score. The third task required the participants to place 25 pegs in a pegboard as quickly as possible using both hands. The time to complete the trial was recorded for the three trials and the fastest time was recorded as the score.

Procedures

All participants were pre-tested on the three hand-eye coordination tests prior to the presentation of the instructional units. Following the completion of the pretest the instructional units were presented. At the end of the three-week instructional unit, all participants were post-tested on all three tests of the pretest.

For the experimental groups, a highly qualified physical education instructor (e.g., the instructor has received several teaching awards) presented the cup stacking unit to the experimental classes. The instructor was trained by watching the video prepared by *SpeedStacks, Inc.* (2000). The instructor was able to complete the stacking tasks without making a mistake prior to the teaching of the unit. Students participated in cup stacking activities (Smith, 2004; SpeedStacks, 2001) for four days per week for a three week period of time. The first two days were spent teaching the students the three and six stacks. Once the instructor was assured that the students could successfully complete the three and six stacks, the ten stack was introduced. The majority of the students (86%) were able to master the ten stack. The remaining lessons supplemented the cup stacking with other activities (i.e., move to a station using a fundamental locomotor skill, upstack and downstack a 6 stack, continue to the other stations performing the required upstack/downstack; upstack a 3-6-3 component, perform 10 sit-ups then downstack the 3-6-3, etc.). Each class was 30 minutes in length with approximately 20 to 25 minutes of actual instructional time. After the first 2 days, the students spent 10-15 minutes in cups stacking activities.

The same instructor presented a standard physical education unit to the control classes during the three week period. This unit did not include cup stacking. Students would perform similar tasks of moving to stations, but rather than cup stacking, the students would dribble or throw a ball or other similar activities for a specified number of times. Within one week of the instructional units, each participant completed each of the three tasks as a posttest.

Results

The scores for each test were analyzed in three separate 3 x 2 x 2 (Grade X Group X Test) ANOVAs with repeated measures on the last factor using SPSS. For the one-handed penny task, the results indicated a significant main effect for Grade $F(2, 98) = 39.94$, $p<.05$. The First/Second graders ($M = 30.8$ sec $SD = 4.4$) were significantly slower than the Third ($M = 25.1$ sec $SD = 2.8$) and Fourth ($M = 23.6$ sec $SD = 2.8$) graders. Additionally, the Grade X Test interaction was found to be significant, $F(2, 98) = 10.35$, $p<.05$, see Figure 1. The times for the First/Second grade group increased from pretest to posttest while the other two groups' times decreased. The other main effects and interactions were not significant, $p > .05$.

The results of the two-handed penny task indicated a significant main effect for Grade, $F(2, 98) = 43.81$, $p<.05$. First/Second graders ($M= 21.2$ sec $SD = 4.3$) were significantly slower than the Third ($M = 16.0$ sec $SD = 2.6$) and Fourth ($M = 14.1$ sec $SD = 2.0$) graders. There was a significant Group X Test interaction, $F(1, 98) = 4.17$, $p < .05$, see Figure 2. The posttest times for the control group were faster than the pretest times for the control group and the pretest and posttest times of the experimental group. The other main effects and interactions were not significant, $p > .05$.

The results of the pegboard task indicated a significant main effects for Grade $F(2, 98) = 34.80$, $p<.05$, and Test $F(1, 98) = 16.92$, $p <.05$. The times for the First/Second graders ($M = 67.5$ sec $SD = 12.0$) were significantly slower than the times for the Third ($M = 51.7$ sec $SD = 9.3$) and Fourth ($M = 49.6$ sec $SD = 7.9$) graders. The times for the pretest ($M = 59.0$ sec $SD = 13.4$) were significantly slower than the times for the posttest ($M = 55.0$ sec SD 13.9). The other main effect and interactions were not significant, $p > .05$.

Discussion

The purpose of the study was to examine the influence of a three-week instructional cup stacking unit on the hand-eye coordination of elementary children. The results of the current study contradict those of Udermann et al. (2004). In the current study, for all tasks, the First/Second graders performed slower than the Third and Fourth graders. For the two-handed penny task, the control groups performed the task significantly faster than the experimental groups on the posttest. The only task that slightly indicated a possible influence of the cup stacking unit on hand-eye coordination was the pegboard task. (Group X Test interaction, $F(1,98) = 2.958$, $p = .089$, the experimental group performed faster on the posttest than the control group on the pegboard task. However, the control group had faster times on the pretest than the experimental group.)

Although cup stacking is not a perceptual motor training program, it is similar to tasks used in these programs. The results of the current study seem to be in agreement with the studies conducted on perceptual motor training that used a relatively large sample size and control groups (see Hammill, Goodman & Wiederholt, 1974 for a review). Thomas and colleagues (Thomas, Chissom, Stewart & Shelley, 1975) found a specificity of training effect for perceptual motor training. This specificity effect is a possible explanation for the differing results between the current study and the Udermann et al. (2004) study. The soda pop test used in the Udermann et al. study would be more specifically related (similar) to the task of cup stacking than the tests used in the current study. The soda pop test

requires the participants to turn soda pop cans over and place them in a specified location. The tests chosen for the current study are tests that are traditionally used in the area of experimental psychology to measure hand-eye coordination. The lack of similarity of the tasks used in the present study could explain the lack of influence from participation in cup stacking.

Another possible explanation for the differing results could be the amount of time spent practicing the task. The Udermann et al. (2004) study had the individuals practicing (training) only cup stacking for 20-30 minutes per day, four days per week, for five weeks. The current study followed the curriculum suggestions provided by the promoters of *Speed Stacks* (2001). Additionally, cup stacking was incorporated into the physical education curriculum (Smith, 2004) following a unit length appropriate for the age group. The entire class period (30 minutes) was not devoted strictly to cup stacking, but the students participated in cup stacking supplemented with other activities in an attempt to increase the level of physical activity (Baumgarten, 2004).

The current study incorporated a real-world use of the cups in the physical education curriculum. The results of informal interviews following the posttest suggested that many of the students initially enjoyed the cup stacking activity. However, several students indicated that the three week unit was too long, and they became bored with the simple activity. In conclusion, the results of this study indicate that participation in a three-week instructional unit consisting of cup stacking supplemented with fitness activities does not significantly improve hand-eye coordination in elementary age children. Research is being conducted by the primary author to determine the effect of long-term participation in cup stacking on the hand-eye coordination of children and adolescents.

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Figure 1. Grade X Test Interaction One-Handed Penny Task

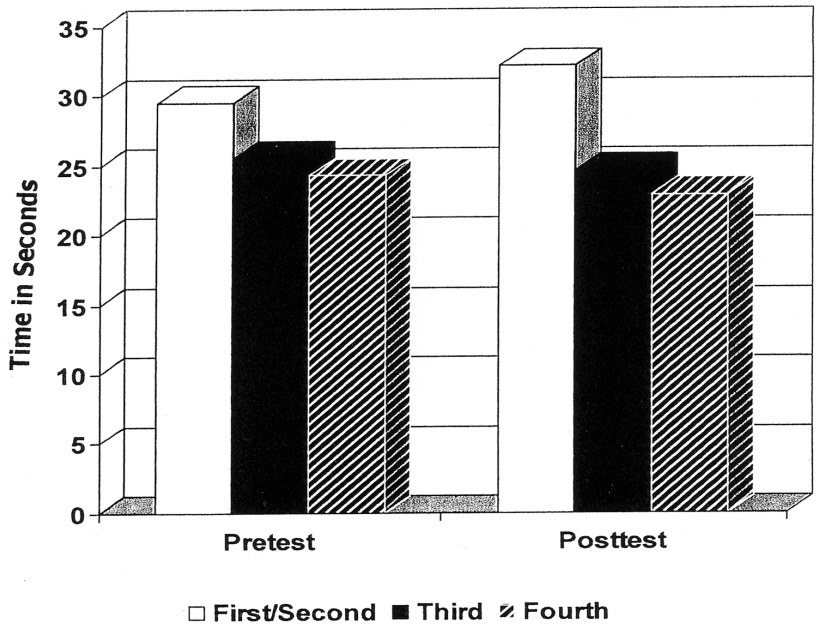

Figure 2. Group X Test Interaction Two-Handed Penny Task