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The Effects of Added Purpose on Fine Motor Performance in Learning Disabled Children

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THE EFFECTS OF ADDED PURPOSE ON FINE MOTOR PERFORMANCE
IN LEARNING DISABLED CHILDREN

by

Sarah Lynn Austin

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
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Western Michigan University
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THE EFFECTS OF ADDED PURPOSE ON FINE MOTOR PERFORMANCE IN LEARNING DISABLED CHILDREN

Sarah Lynn Austin, M.S.
Western Michigan University, 1989

The idea that occupations which offer added levels of purpose elicit a high quality of performance is widely accepted within occupational therapy. In this experiment involving fine motor performance, fifty-three learning disabled children were randomly assigned to two groups. It was hypothesized that children cutting out a circle, presented as a wheel which would complete a paper truck, would cut more accurately than those who cut out the same circle without the suggestion of it being used as a wheel. Accuracy was assessed by measuring the area of the children’s cutting errors. The experimental design included the use of a cutting sample as a possible covariate; however, this variable had no significant impact on the results. The mean scores of the two groups tended in the opposite direction of the hypothesis, with no statistically significant difference. The reasons for the subjects’ unexpected performance were explored.
ACKNOWLEDGEMENTS

I would like to thank David L. Nelson, Ph.D., OTR, FAOTA; Doris A. Smith, M.Ed, OTR, FOATA; and Cindee Peterson, MA., OTR who served as advisors on this project. I would also like to thank my classmates for their support and encouragement throughout the completion of the project, especially Sally Powell who assisted in preparing materials for the study.

Sarah Lynn Austin
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The effects of added purpose on fine motor performance in learning disabled children

Austin, Sarah Lynn, M.S.

Western Michigan University, 1989
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CHAPTER I

INTRODUCTION

Many authors have defined the profession of occupational therapy in terms of its use of purposeful occupations (Ayres, 1960; Evans, 1987; Kielhofner, Burke, & Igi 1980; King, 1978; Kleinman & Bulkley, 1982; Rogers, 1983; Sabari, 1983; Yerxa, 1967). It is generally agreed that what makes an occupation purposeful is orientation toward a goal. Breines (1984) insisted that purposefulness must be defined in terms of the individual who finds purpose in a given occupation. Nelson (1988) has agreed with this position, and further, has noted the role of factors external to the individual in eliciting the purposes that an individual perceives in an occupation. According to his description, external elements, termed occupational form, are given meaning only as they are interpreted by the individual. The meaning that the occupational form has for the individual then determines the purpose, or goal orientation, which the individual develops to guide her/his performance in the occupation. According to this description, all voluntary movement is considered purposeful, for all voluntary movement is goal directed. Simply raising your arms is considered to be a purposeful occupation because you have the goal of raising your arms. However, raising your arms to catch a ball involves an added level of purposefulness.

While the term occupational form is new, much of the literature
of our profession can be considered a discussion of how occupational forms affect performance. Within this body of literature is a smaller group of works which directly address how occupational forms elicit added levels of purpose (Ayres, 1960; Fidler & Fidler 1978; Heck, 1988; Hinojosa, Sabari, & Rosenfeld, 1983; King, 1978; Thibodeaux & Ludwig, 1988; Yerxa, 1967; Yoder, Nelson & Smith, in press; Yuen, 1988). One topic which is addressed in this area of study concerns the effects of added purposefulness on motor performance (Ayres, 1960; King, 1978; Yerxa, 1967; Yoder et al., in press; Yuen, 1988). This issue has been discussed both in terms of improving the quality of motor output and decreasing the fatigue experienced by the individual.

Ayres has theorized that "concentrating very hard on a motion has a detrimental effect on that motion. Similarly, muscles controlled by attention fatigue rapidly" (Ayres, 1960, p. 304). She stated that the use of tasks, which direct attention toward a goal other than the movement itself, improve motor performance. Yerxa (1967) noted an improvement in quality of movement in an activity with added purpose in her description of a client who could not open her hand in spite of intense effort, but who opened it easily when offered a glass of water. King (1978) proposed that occupations which direct conscious attention toward an added goal facilitate the efficient organization of individual movements at a subcortical level, thus improving the quality of the movement. Thus there is a commonly held belief within the field of occupational therapy that occupational forms which provide added purpose improve motor performance in terms of quality of movement, motivation, and fatigue rate. However, the profession has
only recently begun to examine this belief with quantitative research.

Research in this area has focused on the use of added levels of purpose to increase motivation and decrease fatigue rates. Kircher (1984), Steinbeck (1986), Bloch, Smith, and Nelson (1989), and Yoder et al (in press) studied the effects of occupational forms designed to elicit added levels of purposefulness on exercise performance in terms of motivation and fatigue as measured by heart rate or exercise repetitions. These studies all documented that occupational forms designed to elicit added purposefulness had statistically significant effects in terms of exercise performance. However, additional research needs to be done in this area. Motivation and fatigue rate are only two of the facets of an individual's motor performance that are subject to change through occupation. The effects of added purpose on skilled movement, which has such a strong base in the theoretical literature of the profession, has been neglected in terms of quantitative research.

Children with learning disabilities are appropriate subjects for a study of the factors which affect motor performance. Many children with learning disabilities exhibit difficulties in motor performance (Lemer, 1985). This is often evident in the problems that they have writing legibly, cutting with scissors, and performing other tasks that require fine motor control.

In planning treatment for these children, Kephart (1971) placed importance on the goals of activities. He advocated the use of activities with naturally occurring consequences which allow the child to comprehend independently the success or failure of his/her efforts.
A pegboard with round and square pegs is one example of such a task. When the correct peg is put in the correct hole, it fits and success is obvious. He contrasted this with activities such as being given a pegboard with all round holes and round pegs and being asked to make a "pretty" design. In this case, the criteria for success are socially imposed rather than inherent in the activity. Kephart stated that children are more motivated to master tasks that involve naturally occurring consequences because of their motivation to master the natural laws with which they must cope everyday (p. 27). It also follows that predictable, natural consequences should facilitate the accurate development of goals by the child and thus improve performance.

This study examined the effect of an occupational form designed to elicit an added sense of purpose on the fine-motor performance of children with learning disabilities. The specific task under study was cutting out a circle. In the added-purpose version of this task, the circle was presented as the wheel of a fire truck, a presentation considered to have naturally occurring consequences since the wheel must be cut round in order to roll smoothly on a flat surface. This occupational form was designed to provide a criterion for success that could be predicted independently, thus allowing the children to accurately develop goals to guide their movements. It was hypothesized that this occupational form would elicit a higher quality of cutting than a limited-purpose version which involved cutting the same circle without the suggestion of it being used as the wheel of a fire truck.
CHAPTER II

METHOD

Subjects

The subjects in this study were 53 children between 6.54 and 9.56 years old, all of whom had a primary diagnosis of learning disability. Thirty-five of the children had been placed in self-contained classes and eighteen were mainstreamed while receiving special services. The children came from two adjacent school districts which serve an upper-middle-class suburban area. Consent forms were sent home with all of the children with learning disabilities in one district (74 children), and to all the students in one self-contained classroom for learning disabilities in the other district (12 children). Children in both districts had been identified as learning disabled by a special education cooperative which provided contracted services to both districts. The criterion for the diagnosis of learning disability used by this cooperative were: (a) normal intelligence, (b) a specific psychological processing deficit (e.g. attention, discrimination or memory deficits), (c) a discrepancy of at least one standard deviation between achievement and performance, and (d) this discrepancy not being due to other factors such as economic disadvantage. Further information concerning the diagnostic process used by the cooperative is available in a booklet entitled "Learning Disabilities Entrance/Exit Criteria" (Southwest Cook County
Cooperative for Special Education, 1985).

All students who returned a completed form were randomly assigned to control (limited-purpose) or experimental (added-purpose) groups. Information including birth date, grade, and placement (self-contained or mainstreamed) was collected for each child (see Table 1).

Table 1
Subjects' Sex, Grade Level, Placement, Handedness and Age

<table>
<thead>
<tr>
<th>Variables</th>
<th>Added-purpose</th>
<th>Limited-purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Subjects</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>2nd</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>3rd</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Placement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Contained</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>Mainstreamed</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Handedness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>26</td>
<td>25</td>
</tr>
<tr>
<td>Left</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Age (years)</td>
<td>M = 8.11</td>
<td>M = 7.8</td>
</tr>
<tr>
<td></td>
<td>SD = .79</td>
<td>SD = .80</td>
</tr>
</tbody>
</table>

Procedure

Before working with individual children from self-contained
classes, the researcher introduced herself to the class as a whole. At this time, the children were told that they would be asked to cut out three shapes and that the task was not a part of their school work. They were asked to keep the task a secret from the other children, but were told that they may tell any adult what they had done. Mainstreamed children were given the same instructions individually before leaving the classroom. The subjects were then asked one at a time to accompany the researcher to the test area. As the researcher escorted the children to the test site, she used repetition of introductions and neutral questions about the school day to develop rapport.

At the test site, each subject was asked to cut along two arcs. Each arc was positioned in the corner of a three inch square of sixty-seven pound yellow card stock so that a quarter of a one-and-one-half-inch radius circle was described by the printed arc and the two edges of the paper (see Figure 1). An example of a curve cut correctly was placed on the table. Each child was presented with the first paper at midline, and was told, "I want you to cut along this curve. When I give you the scissors, cut on the black line." The researcher then presented the scissors to the child at midline and noted which hand he/she used to cut. Crayola Craft Scissors were selected because they can be used by both right-handed and left-handed children. When the child finished, the researcher presented another copy of the arc at midline, and told the child, "I am asking each child to cut two of these. Remember to cut on the line." When the child finished cutting the second arc, the two quarter-circles that had been produced were
saved to be scored later, and the child was asked to return the scissors to the researcher.

Figure 1. Arc Cutting Task

Subjects randomly assigned to the limited-purpose group were then asked to cut out a circle with a one-inch radius centered in a four-inch square of 100 pound matte card stock (see Figure 2). A solid, one-quarter-inch-diameter dot marked the center of each circle. This circle was printed so that the circle and center dot appeared in white on a black background.

A cut-out circle was placed on the table as an example. The printed circle was then presented at the midline, and the child was told, "Now I want you to cut out this circle. When I give you the scissors, cut on the white line so that the circle will be round like this one" (the researcher indicated the example of a cut out circle). When the child finished, the researcher thanked the child for
participating and repeated the instructions not to tell other children what they had done. The researcher then accompanied the child back to his/her classroom.

Figure 2. Circle Cutting Task

After subjects in the added-purpose group cut the two arcs as described above, the experimenter placed a three dimensional paper fire truck on the table (see Appendix B for specifications). The fire truck had only three wheels, which were attached with brads so that they turned when the truck was pushed. The researcher then glued the two quarter-circles that the child cut out when cutting along the arcs onto the truck to represent the windshield. The children were then presented with the same one-inch-radius circle used with the limited-purpose group. After this circle was presented at midline, they were told, "Now I want you to cut out this wheel. When I give you the
scissors, cut on the white line so that the wheel will be round like this one (the investigator indicated one of the wheels on the truck while pushing it along the table so that the wheels turned). When you are done we will put it on the truck." The researcher then handed the child the scissors as described above. When the child finished, the researcher attached the wheel to the truck, and informed the child that the truck would be returned to him/her next week. The researcher then thanked the child for participating, repeated the instructions not to discuss the task with other children, and accompanied the child back to her/his classroom.

Measures

The quarter-circles and circle which the children cut out were scored using a transparency of a matching arc or circle superimposed on a dot planimeter, composed of a field of randomly distributed dots (See Figure 3). The planimeter is a standardized instrument used by geographers to measure area by counting the number of dots which fall in a given area.

In this study, the planimeter was used to measure the areas of the children's cutting errors. At a density of one hundred dots per square this dot planimeter was marked as having an accuracy of 97% when measuring a shape of at least twelve square inches. For this study, the planimeter was reduced to a density of five hundred dots per square inch. The errors on either side of the printed arc were measured by counting the number of dots within these areas. Dots touching the edge of an error area were counted, while dots which
touched the circle printed on the transparency were not counted.

Figure 3. Measurement Instrument for Circles

The quarter-circles which the children cut out were aligned with the transparency by matching their right angles to the right angle of the quarter-circle on the transparency. The circles were aligned to the transparency using the dot marking the center of each circle. Once aligned, the shapes were taped in place. The principal investigator was responsible for all scoring. Throughout the scoring process, information identifying the subject as a member of the limited or added-purpose group was kept in a sealed envelope attached to the work of each child in order to avoid bias. Interobserver reliability for the measurement instrument was established with an independent
observer comparing the scores of twelve subjects randomly selected from the study. Reliability was calculated by dividing the smaller of the two rater's scores by the larger to determine the percentage of agreement, and then taking the mean. The mean of percentage of agreement was 83% for arcs and 94% for circles.
CHAPTER III

RESULTS

Subjects from the added-purpose group showed a mean area of error of 129.58 in circle cutting with a standard deviation of 114.20. The mean area of error in circle cutting for the limited-purpose group was 92.85 with a standard deviation of 91.46 (see Table 2). These means were in the opposite direction from the hypothesis.

Table 2

Means and Standard Deviations of Area of Error for Added-purpose and Limited-purpose Groups

<table>
<thead>
<tr>
<th></th>
<th>Added-purpose</th>
<th>Limited-purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 26</td>
<td>N = 27</td>
</tr>
<tr>
<td>Area of Error</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc</td>
<td>Median = 10.5</td>
<td>Median = 8</td>
</tr>
<tr>
<td></td>
<td>M = 22.38</td>
<td>M = 20.07</td>
</tr>
<tr>
<td></td>
<td>SD = 30.36</td>
<td>SD = 25.50</td>
</tr>
<tr>
<td>Circle</td>
<td>Median = 73.5</td>
<td>Median = 68</td>
</tr>
<tr>
<td></td>
<td>M = 129.58</td>
<td>M = 92.85</td>
</tr>
<tr>
<td></td>
<td>SD = 114.20</td>
<td>SD = 91.46</td>
</tr>
</tbody>
</table>

The use of the arc cutting task did not appear to have a significant impact on the results and thus was not used as a covariate. Because the data appeared skewed, a Mann Whitney U test was used for statistical analysis. This test produced a $U = 294.0$, two-tailed $p = .32$, showing a lack of statistical significance.
CHAPTER IV

DISCUSSION

This study was designed to provide quantitative support for the theoretically derived hypothesis that the use of added levels of purpose serves to improve the quality of motor performance. However, the limited-purpose group produced a lower mean error area score than did the added-purpose group. This difference between the two groups was not statistically significant; thus interpretations are speculative. However, the added-purpose version of the cutting task appeared to inhibit rather than enhance the children's quality of performance.

Performance time was not measured in this study; however, the children in the added-purpose group appeared to take less time to complete the circle-cutting activity than did the limited-purpose group. There may have been a connection between the higher error rate of the children in this group and the speed with which they finished. Children who found making the truck a motivating task may have been motivated to finish quickly, rather than to cut carefully. Since the children in this study were not timed, this interpretation is based on conjecture. This interpretation suggests that the anticipation of a tangible end product may have distracted the children from the need to cut accurately. This would suggest that maximizing the fine motor performance of learning disabled children may require that tasks be
presented in a simple, non distracting manner.

Distraction has been discussed as an important property of added-purpose occupations in previous studies. Heck (1988) attributed the increased pain tolerance in his subjects to the distraction provided in an added purpose activity. In discussing her results, Kircher (1984) suggested that participation in an added-purpose occupation provided a distraction which decreased the subjects' perception of fatigue. In both of these studies, distraction increased performance. The results of the current study also suggest that added-purpose occupations provide distraction; however, in this case, distraction appeared to inhibit performance. This would suggest that it may not be appropriate for all therapeutic methods to be designed as added-purpose occupations. This in turn suggests a need for a thorough examination of the role of distraction in the use of added-purpose occupations, both through research and in clinical practice.

The fact that the limited-purpose condition resembled a testing situation may also have affected the results. Children in this group may have been more self-conscious and thus more attentive to the quality of their performance. This interpretation would suggest that a certain amount of anxiety may improve the performance of children with learning disabilities. However, while it may improve performance for a given trial, there may be other benefits in using added-purpose occupations with this population. Kirk (1987) has presented the problem of motivating learning disabled children to participate in activities that can help to improve areas in which they have deficits.
He emphasized the need to find ways of motivating these children, and reports that there is a consensus among authorities that intrinsic motivation is preferable to extrinsic motivation. The results of this study suggest that added-purpose occupations provide intrinsic motivation to these children. If this is the case, added-purpose occupations may benefit the children over the long run by fostering a sense of enjoyment in the activity. This may encourage practice, thus improving skill over time in spite of the fact that the quality of the products may be compromised in the short term.

It may also have been the case that the children's failure to attend to the quality of their work was due to the design of the occupational form. Although an attempt was made to design the truck completion occupation so that the need to cut round wheels would be inherent in the occupation and readily apparent to the children, the results suggest that this was not the case. A different occupational form may have elicited the desired response. It would be necessary to design such an occupational form so as to make clear to the participants the purpose of producing a quality product. The design of the occupational form utilized to provide an added-purpose task in this study did not meet this criterion because children who cut inaccurately could still use their trucks in much the same manner as those who cut more accurately.

A future study could address this problem by presenting both groups with examples of both accurately and inaccurately cut circles before they cut out circles. The researcher could then ask the children in the control group which circle was rounder. The children
in the experimental group could be asked which wheel will roll better. The addition of this procedure would provide a cue to the desired performance for both groups. It may then be the case that the children who are asked to cut out wheels will cut more accurately because they will realize the consequences of their performance.

Designing occupations which make the need for quality clear, which provide a product which can be measured for quality, and which can be matched to a control condition provides great challenge to researchers interested in investigating the effects of added purpose on quality of performance. However, this challenge must be met in order to fully examine the effects of added-purpose occupations, and thus provide a quantitative base for the use of occupations in occupational therapy.

The lack of statistical significance, as well as the lack of data documenting the children's performance time, limits the conclusions which can be drawn from this study. Future studies should be structured in such a way as to assess performance as measured by performance time as well as the quality of the end product. Both of these are important but distinct measures of performance. The use of both these measures could provide greater insight as to the meaning individuals assign to various occupations and the purposes on which they subsequently base their actions.
CHAPTER V

CONCLUSION

This study attempted to provide a quantitative base for the idea that an added-purpose occupation can elicit a higher level of fine motor performance than a similar limited-purpose occupation. The results of the study were not in the hypothesized direction. The use of an added level of purpose appeared to distract the subjects from the quality of their work, leading to decreased performance. Further study may provide a better understanding of the role of distraction in added-purpose occupations.
Appendix A

Letter of Informed Consent
Dear Parents-

I am a graduate student in occupational therapy at Western Michigan University.

I am planning to conduct a study in your child's school concerning factors that affect children's ability to cut with scissors. I will be asking each child to cut out two quarter circles and one full circle. Some of the children will be asked to complete a simple art project with these shapes. I will then measure the quality of their work.

Confidentiality will be maintained throughout this study and no record of your child's name will leave the school building.

I would like to ask your permission to have your child participate in this study. You are free to withhold your permission, or withdraw your child at any time without penalty. If you wish to give this permission, please sign this form and return it to the school as soon as possible. If you have any questions, or if you would like to have a copy of this form, please call me.

Sarah L. Austin  
367 Westgate  
Park Forest, IL 60466  
747-0499

Consent:

I have been informed of the purpose and procedures involved in this study and have agreed to give permission for my child ____________________________ to participate.

___________________________  ________________________
Signature of Parent or Guardian  Date
Appendix B

Description of Fire Truck (Research Stimulus)
The fire truck was made from three parts, a box (see Figure 1) and two facades (see Figure 2). All of these pieces were printed on fade-resistant red construction paper. The facades were then glued to the sides of the box.

**Figure 1. Box**

**Figure 2. Truck Facade**
Wheels were cut from the same papers used as the dependent variable in the study. The wheels were attached to each truck with half inch brass brads. The front, left-hand wheel was not attached in order to leave room for the wheel cut by the subject.
Appendix C

Western Michigan University
Human Subjects Institutional Review Board
Exempt Approval Form
TO: Sarah L. Austin  
FROM: Ellen Page-Robin, Chair  
RE: Research Protocol  
DATE: January 30, 1989

This letter will serve as confirmation that your research protocol, "The Effects of Added Purpose on Fine Motor Performance in Learning Disabled Children" is now complete and has been signed off by the HSIRB.

If you have any further questions, please contact me at 387-2647.


Southwest Cook County Cooperative for Special Education. (1985). *Learning Disabilities Entrance/Exit Criteria*. (Available from Southwest Cook County Cooperative for Special Education, 151st Street, Oak Forest, IL)


