Efficacy of a Manualized Intervention, *Pencil Gymnastics*, on Improving Manual Dexterity for 5 to 7 Year Old Children

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Abstract
This quantitative pre-test post-test study investigated a manualized intervention, *Pencil Gymnastics*, to determine its efficacy in improving manual dexterity in children (n=13) between the ages of 5 and 7 years old. The main focus of *Pencil Gymnastics* is to ready the hands for tripod grip and pencil control, while strengthening the extrinsic and intrinsic muscles of the hands. The intervention addresses this through the use of prescribed finger exercises utilizing a pencil, set to familiar childhood songs. Prior to this study, no research has been completed to investigate the efficacy of prescriptive interventions that address manual dexterity and fine motor skills in children. This pilot study adds to the current base of evidence to support a manualized intervention that can be used to improve fine motor and manual dexterity deficits in children.

Literature review
A review of the current literature shows that manual dexterity skills in children are instrumental in fostering their engagement in occupations such as self-care, education, and play. Occupational therapists are the primary practitioners who address manual dexterity deficits and the effects that such deficits could have on occupational participation. Many manualized interventions claim to remediate manual dexterity deficits in children, including *Handwriting Without Tears*, *Callirobics*, *Fine Motor Olympics*, and *Pencil Olympics*, however there is currently no research in the literature to support these claims. For this reason, it is important to conduct research on an intervention addressing manual dexterity deficits.

Methodology
This investigation utilized a quasi-experimental, pre-test post-test, quantitative pilot study. Four occupational therapy graduate student researchers conducted eleven 30-minute *Pencil Gymnastics* intervention sessions over a six week period at a private, parochial elementary school in the San Francisco Bay Area. Descriptive data from the intake form provided demographic information such as the child’s age, gender, grade, and participation in current occupational therapy services. Non-parametric quantitative data was collected during the evaluation and reevaluation using the manual dexterity, upper-limb coordination, fine motor precision, and fine motor integration subtests of the Bruininks-Oseretsky Test of Motor Proficiency Second Edition (BOT-2). Score sheets provided data on the child’s performance before and after participation in the intervention in the form of a pre-test and post-test evaluation.

Of the twenty children between the ages of 5 and 7 identified by either the teacher or the parent as having manual dexterity deficits, thirteen met the inclusion criteria to participate in the study. Inclusion criteria for the study included scoring in the “below average” or “well-below average” range on one or more of the subtests on the pre-test of the BOT-2. Of the thirteen children who qualified for the study, twelve children were present and provided data for the re-evaluation. Using the Statistical Package for the Social Sciences (SPSS), a two-tailed Wilcoxon signed-rank test was run on the pre-test and post-test scores of each of the BOT-2 subtests.

Results
The results of the Wilcoxon signed-rank test showed a statistically significant improvement in manual dexterity (Z= -2.320, p = 0.020), upper limb coordination (Z= -2.805, p = 0.005), and fine motor integration (Z= -2.556, p = 0.011). There was no statistically significant improvement in fine motor precision (Z= -.551, p = 0.582).

Discussion
According to this study, *Pencil Gymnastics* was effective in improving manual dexterity, upper limb coordination, and fine motor precision.

- **Clinical Implications**
  - Occupational therapists are the primary practitioners who address manual dexterity deficits and the effects such deficits could have on occupational participation. Many manualized interventions claim to remediate manual deficits in children, including *Handwriting Without Tears*, *Callirobics*, *Fine Motor Olympics*, and *Pencil Olympics*, however there is currently no research in the literature to support these claims. According to the results of this investigation, there is now evidence to support the efficacy of
*Pencil Gymnastics* as a manualized intervention that improves manual dexterity and fine motor skills in school-aged children.

- **Take-Away**
  - The results of this study propose that the manualized intervention, *Pencil Gymnastics*, is effective in making significant changes in participants’ fine motor and manual dexterity skills after eleven 30-minute group sessions. With future research to support such a claim, occupational therapists may now have a simple, prescriptive, evidence-based intervention to use to address manual dexterity and fine motor deficits in school-aged children.

- **Limitations**
  - The study used a pre-test post-test design with no control group, which is subject to a type 1 error, whereby the study reports a relationship when there may not be any relationship. Additionally, participants were selected using a convenient sample from one kindergarten and one first grade classroom in a parochial, private school in the San Francisco Bay Area. Therefore, the sample may not adequately represent the population of children with manual dexterity deficits. Lastly, inconsistency in test administration of the fine motor integration subtest of the BOT-2 may have skewed data results for this specific subtest.

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*The *Pencil Gymnastics* intervention was created by Jo Tennyson Samson, MA Ed, OTR/L, CHT. For questions regarding the *Pencil Gymnastics* intervention, please send an email to johandfoot@aol.com.

**References**


