Comparing Ways of Measuring Constructional Praxis in the Well Elderly

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The purpose of this study was to explore ways of testing three-dimensional constructional praxis in the independently living well elderly. The testing instruments used were adaptations of the block construction portion of the Boston Diagnostic Aphasia Examination, the block construction portion of the Hemiplegic Evaluation, and the Three-Dimensional Constructional Praxis Test. For each instrument, three types of test administration were developed: models, photographs, and drawings of block constructions. Twenty-four subjects, all more than 70 years old, were tested individually with the three-dimensional constructional praxis tests on the three types of test administration. The effect of order was controlled by counterbalancing. For all three tests, administration with models resulted in the highest performance scores. Although no difference in scores existed between photographs and drawings on the Boston Diagnostic Aphasia Examination and the Three-Dimensional Constructional Praxis Test, performance scores for photographs were significantly greater than scores for drawings on the Hemiplegic Evaluation. Since constructional praxis ability is an important component of many activities of daily living, the findings have strong implications for testing and for teaching new skills to both the well elderly and those disabled by neurological disorders.

Constructional apraxia is a term that has been used to describe a form of perceptual-motor impairment commonly demonstrated by persons who have sustained a severe head injury or cerebral vascular accident (Baum & Hall, 1981; Benton & Fogel, 1962; DeRenzi & Fagolini, 1967; Lorenze & Cancro, 1962; Warren, 1981). It has been found to be related specifically to the parietal lobes (Allison, 1970; Anderson, 1967; Anderson & Choy, 1970; Critchley, 1966; Hécaen & Albert, 1978). Age-related changes may also produce signs of constructional apraxia in the well elderly (Farver & Farver, 1982).

According to Benton (1967), Kleist originated the concept of constructional apraxia, which he defined as a disturbance in the spatial aspects of assembling, building, and drawing. In other words, constructional apraxia is the inability to organize separate parts into a unified whole. For occupational therapists, it is important to evaluate constructional praxis in neurologically impaired patients and plan treatment accordingly because many activities require some skill in constructional praxis. The activities of daily living of a person with constructional apraxia are particularly affected (Baum & Hall, 1981; Lorenze & Cancro, 1962; Warren, 1981). Common functional activities that require constructional ability include dressing, setting a table, making a bed, assembling an appliance from written and/or illustrated instructions, and packing a suitcase.

Tasks used to test for this dysfunction are many and varied. They may be simple, such as copying geometric figures (Baum et al., 1979), horizontal block or stick arrangements (Critchley, 1966), or vertical block building (Benton, 1979); or they may be complex, such as three-dimensional block constructions or construction from an abstract representation rather than a model (Benton & Fogel, 1962; Weschler, 1955). Benton (1979) stated that these diverse tasks are not equivalent in "their demands on sustained attention, the capacity for deliberation, perceptual acuity, the apprehension of spatial relationships, judgment of perspective, and motor skill" (p. 221). All are, however, considered measures of constructional praxis. In a systematic neuropsychological examination of 100 subjects with cerebral damage, Benton (1967) found that intercorrelations between performances of these subjects in four tests of constructional ability supported the idea that constructional apraxia was the manifestation of at least two separate neuropsychological deficits and, as such, could not be determined by a single test. Benton's conclusions were disputed by Baum and Hall (1981) who tested the performance of head-injured adults on measures of constructional praxis that included graphic praxis tasks, two-dimensional praxis tasks (designs made with match sticks or
simple vertical structures), and three-dimensional praxis tasks. They found no significant difference in performance on those types of tasks and concluded that it was unnecessary to test all three areas of praxis ability with the head-injured population. It is questionable, however, whether a direct comparison of three different dependent variables is valid. Although all three tasks depended upon constructional skill, each required a particular type of constructional praxis ability.

Not only are the tasks used to evaluate constructional praxis diverse, but methods of test administration differ. Some tests require construction from a model (Benton & Fogel, 1962), others from photographs (Goodglass & Kaplan, 1972), and still others from abstract pictorial representation in reduced scale (Kohs, 1923; Weschler, 1955). Benton and Fogel (1962) found that these varied methods of administration make different demands on symbolic and conceptual functions and perceptual analysis. It has also been shown that both brain-damaged and control subjects perform better with a block model than with a photographic presentation (Benton, 1973). Thus, the method of test administration appears to be an important variable in test performance.

In their study of normal adult performance on tests designed to assess parietal lobe functions, Farver and Farver (1982) found that older subjects had more difficulty than younger subjects on tasks with a strong visuospatial component. Results indicated this to be true as well for block constructions by individuals more than 70 years old. Among the tests used in the study were the Parietal Lobe Tests of the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972). In these tests, block constructions were reproduced from photographs. Farver and Farver determined that persons older than 70 years could not be expected to perform as well on constructional tasks as younger persons. A study conducted by Taylor (1968) found a slight decrease in accuracy in block constructions from models for normal subjects 64–74 years of age using Benton and Fogel’s (1962) Three-Dimensional Constructional Praxis Test. She found that accuracy could be achieved by older subjects, but only at the expense of time. These studies indicate that constructional skills decrease with age and that the method of test administration affects accuracy of performance.

The present study was designed to evaluate constructional praxis as assessed by three-dimensional block constructions, which has significant impact on many activities of daily living. Three different methods of test administration were used—models, photographs, and drawings—to determine the effects of test administration on three-dimensional constructional performance. Well elderly persons 70 years old and older were chosen as subjects, because previous studies (Farver & Farver, 1982; Taylor, 1968) found age-related changes in performance on block construction tasks. It was also felt that understanding the normal ranges of performance for the well elderly would help in interpreting the ranges of performance in the elderly disabled by cerebral vascular accident or brain injury or disease. The block construction portion of the Boston Diagnostic Aphasia Examination (Boston) (Goodglass & Kaplan, 1972), the block construction portion of the Hemiplegic Evaluation (Hemiplegic) (Baum, et al., 1979), and the revised version of the Three-Dimensional Constructional Praxis Test (3-D) (Benton, 1973) were used in developing the three-dimensional construction tasks.

The following outcome was hypothesized: The well elderly subjects will be most successful at three-dimensional construction tasks when tests are administered from models, less successful when photographic presentation is used, and least successful when drawings are the test stimuli.

Method

Subjects

The subjects in this study were drawn from a senior citizens’ apartment complex. Criteria for inclusion in the study were as follows: Subjects had to (a) be 70 years old or older; (b) be considered to be independently living, well elderly (i.e., living without current need of part- or full-time nursing care); (c) have vision correctable to a 20/200 level; (d) be able to identify correctly the colors red, yellow, blue, green, and orange; (e) have hearing of a functional level as determined by observation and understanding of and response to conversation; and (f) have no history of any neurological diseases or injuries influencing perception, language, or cognition. Thirty subjects were randomly assigned to one of three experimental groups; each group differed in order of type of test administration. Three subjects withdrew during the experiment (i.e., one from Group 1 and two from Group 3). Two subjects were then randomly dropped from Group 2 and one subject from Group 1 in order to have the same number of subjects in each group. This left a total of 24 subjects, or eight subjects in each experimental group. Subjects ranged in age from 71 to 89 years, with a mean age of 80 years.

Instruments

Three tests of three-dimensional constructional praxis were used: the block construction portion of Boston, the block construction portion of Hemiplegic, and 3-D. Information regarding the reliability and validity
of these tests was not available. Each block construction task was administered in three different ways: from models, photographs, and drawings. Models were constructed and glued together so that they would remain the same throughout the testing and so that subjects would not observe the construction of the models. Photographs for Boston and 3-D were black and white, ranging in size from exact scale to approximately one-half scale. Photographs for Hemiplegic were in color, and all were to scale. Drawings for Boston and 3-D were black and white, and drawings for Hemiplegic were in color. All drawings were to scale.

Procedure

All members of each group were tested in each testing session with the block construction tasks developed from Boston, Hemiplegic, and 3-D. As mentioned earlier, each task was administered from models, photographs, and drawings. The tasks were always administered in the same order with Boston first, Hemiplegic second, and 3-D third; however, the method of administration of the tasks was counterbalanced.

Subjects were tested individually by the same examiner in sessions lasting approximately ½ hour. Testing occurred over a 3-week period with one testing session per subject per week, until all of the subjects had been tested with the three block construction tasks on all three methods of test administration. Scores for each test represented the total number of correct block placements for all block construction tasks in that test. Block construction tasks were timed according to the instructions of each test manual; however, subjects were allowed to continue working on a construction until they indicated that they were finished. This resulted in a time-corrected score for each task. Time-corrected scores were analyzed because a ceiling effect frequently occurred for raw scores.

Results

This study examined three dependent variables: Boston, Hemiplegic, and 3-D. There were two independent variables for each dependent variable: type of test administration and order. Type of test administration had three conditions: models, photographs, and drawings of block constructions. For each dependent variable, a two-way analysis of variance (Order x Type of Test Administration) with the three types of administration treated as a repeated measure was performed.

Table 1 summarizes the means and standard deviations for each dependent variable for each type of test administration. There were significant differences in performance on all three dependent variables (for Boston, $F(2,42) = 55.5, p < .001$; for Hemiplegic, $F(2,42) = 9.0, p < .005$; and for 3-D, $F(2,42) = 11.3, p < .001$).

Newman-Keuls analysis, with significance set at the .05 level, revealed that for both Boston and 3-D, scores on models were significantly greater than those for photographs and drawings, and a comparison between drawings and photographs was not significant. For Hemiplegic, scores on models and scores on photographs were significantly greater than those on drawings, and a comparison between models and photographs was not significant. The difference in results for Hemiplegic may be due to the fact that blocks used in Hemiplegic were varicolored, uniformly sized cubes, whereas blocks used in Boston and 3-D were all almond-colored and of various sizes. The differences in color and size may have contributed to the difference in results for Hemiplegic. There were no significant main effects for order. The only influence of order was its interaction with type of administration for Boston. The significance of the interaction was small ($F = 3.8$) in comparison with the significance of the main effect ($F = 55.5$). In summary, practice had little effect on performance.

A significant negative correlation between performance and age was found on Boston ($r = -.33, p < .01$, two-tailed). Correlations between age and Hemiplegic and 3-D were also negative, but not statistically significant.

Discussion

The results suggest that constructional praxis performance is influenced by type of test administration. Administration using models resulted in significantly higher scores than the other administration techniques. Scores for administration from photographs and drawings were similar on two of three tests, possibly indicating that these two types of administration made similar perceptual demands, at least for this.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Scores for the Three Measures of Constructional Praxis on the Three Types of Test Administration</th>
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<tbody>
<tr>
<td>Test</td>
<td>Drawings</td>
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<td>$M$</td>
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<tr>
<td>Boston</td>
<td>412</td>
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<tr>
<td>Hemiplegic</td>
<td>115</td>
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<td>3-D</td>
<td>25.8</td>
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</tbody>
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Note. Boston = Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972). Hemiplegic = Hemiplegic Evaluation (Baum et al., 1979); 3-D = Three-Dimensional Constructional Praxis Test (Bemon, 1973).

$p < .005$. **$p < .001$.
group of well elderly subjects. These findings agree with those of Benton (1983), who found that constructional tasks were more difficult for persons with no history or evidence of brain damage when they used a photograph rather than a block model as a guide. The ceiling effect that was encountered for some tasks when time restraints were not imposed on task performance indicates that accuracy can be obtained by normal elderly subjects, but only at the expense of time. This observation was also made by Taylor (1968) in her study of age-related performance changes.

The results of this study have important implications for occupational therapists. First, type of test administration affects scores in a test of constructional ability. Second, performance varies depending upon method of test administration. Finally, as indicated by Benton (1983), constructional deficits, which are not apparent in a person’s performance on simpler tasks, are often revealed by more complex tasks.

It is also possible that different perceptual skills are required by the three types of test administration. A person may be weak in one perceptual skill, such as the spatial interpretation of drawings, but strong in another perceptual skill, such as the spatial interpretation of models. The consideration of such differences is important when testing for three-dimensional constructional praxis ability if the evaluation is to be discriminative.

In teaching a constructional skill to a well elderly person or to a person with a neurological disorder, it can be hypothesized that a model or demonstration of the desired performance will tend to result in greater success than pictorial or schematic directions. Treatment could be graded by introducing a new skill through model or demonstration, and, as the person’s skill increases, pictorial or schematic directions for the same skill could be introduced. This sequence might also be helpful in developing home programs for patients, because these programs are often given to a patient in pictorial or schematic form, which must then be interpreted at home by the patient or a family member.

Future research is needed to investigate why people perform constructional tasks better with models than with photographs or drawings. Further examination of the perceptual skills necessary for performing constructional tasks using models, photographs, and drawings as guides, and the developmental sequence of these perceptual skills would also aid occupational therapists in evaluating and teaching constructional tasks. In addition, it may be of value to repeat this study with various younger normal populations to determine possible age-related constructional praxis performance changes. Such information would allow occupational therapists to more closely match treatment with an individual’s perceptual skills, resulting in more effective and successful treatment.

Conclusion

Performance on constructional praxis tasks is significantly affected by the type of stimuli used for presentation. The findings from this study add to the ongoing efforts of the profession of occupational therapy to help individuals maintain or attain the highest possible level of functional independence.

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References


