Correlation of the Bruininks-Oseretsky Test of Motor Proficiency with the Southern California Sensory Integration Tests

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Correlations between the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) and the Southern California Sensory Integration Tests (SCSIT) were studied by using test results obtained from a sample of 49 learning-disabled children. It was found that those SCSIT tests with a motor component correlated significantly with the BOTMP battery composite scores. The fine motor composite scores of the BOTMP reflected the greatest percentage of significant correlation with SCSIT tests. These results suggested that the BOTMP would be useful for screening children for referral to occupational therapy by educators. In addition, the high correlation of the BOTMP with the SCSIT motor tests indicated that the BOTMP may be appropriate for use in clinical research to evaluate the effectiveness of sensory integrative procedures in relation to motor function.

A number of studies have explored the effectiveness of sensory integrative treatment on academic performance (1-5). Changes in motor performance following sensory integrative therapy have also been examined (6-11). Aspects of motor performance that have been evaluated include eye-hand coordination (10, 11), balance and motor coordination (6), gross motor abilities (8, 9), and neurodevelopmental items (7). Various tests were used to evaluate changes in motor performance in these studies: the Southern California Sensory Integration Tests (SCSIT) (8); the Cratty Gross-Motor Test (9); the Buktenica Developmental Test of Visual Motor Integration (10); and a test of finger tapping by Knights and Moule (10). In addition, the authors of one study (7) used a clinical tool for assessing the neurodevelopmental status of children with minimal cerebral dysfunction.

The results of studies evaluating motor performance suggest that sensory integration therapy has a positive effect on motor ability in

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normal preschool children (8, 9) and in children with learning disabilities (6, 10, 11). However, these results often have not reached statistical significance. One of the reasons suggested for this was that inadequate criterion measures were used to evaluate the effectiveness of sensory integration therapy (8). For example, the use of the SCSIT (a diagnostic test) as a pre-and post-program measure has been discouraged by its author, as well as by other researchers (6). Other problems include the use of clinical evaluations that lack normative data (7) and tests that fail to report retest and inter-rater reliability scores (9). This prevents replication of results and limits generalization of information.

A recent test, not widely used to date, that enables classification of motor performance into gross, fine, and composite ability is the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) (12). For reasons that will be discussed, this test appears to meet all the criteria for a valid and reliable pre- and post-program measure of motor ability. The test originated in 1923 when Oseretsky developed a motor test similar in construction to that of Binet. Oseretsky used five categories: general static coordination; dynamic coordination of the hands; general dynamic coordination; motor speed, and simultaneous voluntary movements. Various researchers used the Oseretsky test and published adaptations for use with mentally deficient children and adults (13), normal children between the ages of 6 and 14 years (14), and children with neuromotor dysfunction (15). Arnheim and Sinclair (16) reported that the original Oseretsky scale was employed primarily as a clinical research test, but has been used increasingly in educational programming. Its two detractions were length of time to administer and difficulty in interpretation. Therefore, in 1978 Bruininks restandardized an adaptation of the Oseretsky test on a population of 800 American school children between the ages of 4 and 14. This revision overcame the problem of excessive length by introducing a short screening form, which requires 15 minutes to administer, as well as the longer, more detailed evaluation. Bruininks included items that examine balance, strength, and visual motor control in addition to measures of coordination and speed. Retest and inter-rater reliability reported for this test reach acceptable levels. In addition, the test is easy to administer by therapist and teacher alike and has the added advantage of reporting results as age equivalences as well as standard and percentile scores.

One of the theorized outcomes of
sensory integration therapy is improved motor performance. The previous discussion has highlighted some limitations of the assessments used to evaluate this change. These limitations include the use of a diagnostic test and nonstandardized clinical assessments. The BOTMP appears to overcome many of these limitations since it is recent, well standardized, covers a wide age range, and reports measures of reliability. In Australia, for instance, this test is used more and more by educators (physical educators, guidance officers, and class room teachers) to evaluate gross and fine motor performance. Therefore, a question requiring attention is whether or not the BOTMP is a suitable assessment test for the evaluation of sensory integration treatment programs. This is now explored by looking at the relationship between results on the BOTMP and SCSIT, the latter being widely used by occupational therapists to evaluate sensorimotor performance. If the motor items on the SCSIT correlate significantly with gross and fine motor scores of the BOTMP, it is possible that these two tests are measuring similar abilities. If so, then the BOTMP may be a valid and reliable choice for therapists undertaking sensory integration research.

**Methodology**

**Subjects.** Forty-nine children (32 boys and 17 girls) ranging in age from 4 years, 10 months to 12 years, 2 months participated in the study. The mean age was 7 years, 2 months, with a standard deviation of 1.2 years. All children had been referred to occupational therapy by teachers and had been identified as learning disabled on the basis of academic and intelligence testing.

**Procedures.** Children were seen over a 12-month period, either at a university clinic or at a remedial education center. They were tested at the time of initial contact and before therapy, using the Southern California Sensory Integration Tests (SCSIT) (17) and the long form of the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) (12). The SCSIT is of diagnostic assistance in determining the nature of sensory integrative dysfunction, whereas the BOTMP is designed to measure gross and fine motor skills and does not provide diagnostic information. The long form of the BOTMP was chosen in preference to the short form, since the latter is a

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**Table 2**

Simple Correlation between the Tests of SCSIT and BOTMP

|         | Spatial Visualization | Figure Ground | Position at Space | Design Copy | Kinesthesia | Manual Form Perception | Finger Identification | Localization of Tactile Stimuli | Double Tactile Stimuli | Imitation of Patterns | Bilateral Motor Coordination | Standing Balance Open | Standing Balance Closed | Crossing Midline | Crossing Midline Crossed | Right-Left Discrimination | Motor Accuracy (most accurate) | BOTMP Fine |
|---------|-----------------------|---------------|------------------|-------------|-------------|------------------------|-----------------------|--------------------------|----------------------|---------------------|---------------------------|----------------------|------------------------|----------------|-------------------------|---------------------------|----------------------|
| BOTMP Fine | .56*                  | .19           | .45*             | .60*        | .29         | .58*                   | .53*                  | .68*                     | .03                  | .49*                 | .52*                      | .53*                 | .67*                   | .69*           | .53*                    | .52*                      | .28                   |
| BOTMP Gross | .05                  | -.36          | .05              | -.24        | .42*        | .28                   | .46*                  | .36*                     | .44*                 | .33*                 | .75*                      | .61*                 | .65*                   | .60*           | .06                     | .25                        | -.19                 |
| BOTMP Comp. | .45*                 | .26           | .35              | .49*        | .51*        | .40*                  | .27                   | .34                      | .30                  | .24*                 | .58*                      | .41*                 | .69*                   | .64*           | .26                     | .36                        | -.07                 |

Using a two-tailed t-test, a correlation of .238 is necessary for significance at the .09 level, and .372 at the .01 level.

*Those tests that reached significance at the .01 level.
screening test and therefore unsuitable for pre- and post-program evaluation.

Each child was tested individually in two 45-minute sessions by therapists certified or trained in the use of both procedures. Only two therapists were involved and each was responsible for administering all tests for each child. The BOTMP was administered first, followed by the SCSIT.

Results

Results from the SCSIT and the BOTMP for the sample population are summarized in Table 1.

Standard and extrapolated (for the three children above SCSIT standardization ages) scores from the SCSIT were correlated, using the correlation matrix from the Statpack Statistical Package (18), with standard fine, gross, and composite motor scores. It is important to note that extrapolated results are not ideal, especially for the tactile tests that tend to ceiling with older children; however, given that this applied only to three children, their results were included. Results appear in Table 2.

The fine and gross motor components of BOTMP comprise separate subtests, whereas the composite score consists of the fine and gross motor scores plus the subtest for upper limb motor coordination. It can be seen from Table 2 that Space Visualization, Design Copy, Kinesthesia, Manual Form Perception, Imitation of Posture, Bilateral Motor Coordination, Motor Accuracy, Crossing the Midline, Crossing the Midline Crossed, Graphesthesia, Bilateral Motor Coordination, Imitation of Posture, and Standing Balance Eyes Open and Closed. Of these tests it was found that only Crossing the Midline, Crossing the Midline Crossed, and Graphesthesia did not correlate with BOTMP battery composite scores at the 0.01 significance level. Graphesthesia correlated at the 0.05 level, however, and Crossing the Midline Crossed and Uncrossed approached this level of significance.

These findings suggest that the BOTMP battery composite score is useful in detecting those children with motor problems that may have an underlying sensory integrative basis. Therefore, the BOTMP could be used as a suitable assessment for monitoring motor changes in children involved in sensory integrative treatment. The remaining SCSIT Tests that correlated with the BOTMP battery composite scores emphasized the visual perceptual nature of the items.

The fine motor composite score of BOTMP reflected the greatest percentage of significant correlation with SCSIT tests. This may be related to the content of the three tests that comprise the fine motor composite. In all these tests, fine motor planning contributes substantially to the composition of the individual items. Furthermore, speed of performance, bilateral motor coordination, and visual perceptual ability are measured in one or more tests; therefore, the relationship between BOTMP fine motor composite scores and many SCSIT tests is, to some extent, explained by the fact that they appear to be measuring similar abilities.

The gross motor tests of the BOTMP measure running speed and agility, balance, bilateral motor coordination, and strength. It could be expected that the SCSIT items that correlate most strongly with the gross motor tests would be the perceptual motor tests. Significant correlations were evident with all such tests with the exception of Right-Left Discrimination and Crossing the Midline. The BOTMP gross motor test construction is such that only dominant hand and foot responses are evaluated. No tests measure ability to cross midline or allow the subject to discriminate between the use of right or left hand.

It was found that the BOTMP composite scores correlated significantly with all tests of the SCSIT that involve a gross or fine motor component. This has implications for the use of the BOTMP as a means for referring children to occupational therapy clinics by physical educators, psychologists, and teachers. The fine motor section of
BOTMP also correlated significantly with all the tests of the SCSIT that involved a motor component. Likewise, the BOTMP correlated with other sensory integrative functions such as visual and tactile perception. It was noted that 14 of the 18 tests of the SCSIT correlated significantly at the 0.01 level with the fine motor composite score of the BOTMP, suggesting that the fine motor section alone may be useful for screening children with sensory integrative dysfunction. The items in this section require less equipment and take less time to perform than the remainder of the battery and therefore may be particularly useful in identifying children with sensory integrative dysfunction. Since Kinesthesia is the only SCSIT test that does not correlate with the fine motor composite but does correlate with the gross, perhaps the addition of a measure of this component to the fine motor items would make a suitable screening assessment.

The SCSIT tests that consistently correlated with all sections of the BOTMP were Standing Balance Eyes Open and Closed, Imitation of Posture, and Bilateral Motor Coordination. The finding concerning Standing Balance can be explained in several ways. First, standing balance may be a mature-level motor skill and difficulty with it may reflect an accumulation of underlying, lower-level problems in both the areas of fine and gross motor skill performance. Second, questions arise about the children sampled in this study. Learning-disabled children have been shown to have a more impaired equilibrium reaction than their non-learning-disabled counterparts (19). Hence, since Standing Balance is the only SCSIT test that examines equilibrium reactions, it could simply be highlighting the cumulative effects of poor performance in both fine and gross motor tasks.

Elements of the two other tests, Imitation of Posture and Bilateral Motor Coordination, appear repeatedly in both the fine and gross motor BOTMP tests. Ayres, in her latest factor analysis study (20), also found Imitation of Posture to be a strong indicator of sensory integrative dysfunction. In addition, the Upper Limb Coordination subtest of the BOTMP is included in the total battery composite. Since this is heavily weighted in areas of bilateral motor coordination (e.g., bouncing balls and catching with both hands together) and motor planning (e.g., throwing balls at targets), such a result would be expected.

Conclusion
Two important findings resulted from this study. First, the BOTMP, long form, met the requirements of being a valid and reliable test for assessing motor function in those children with learning disabilities. Its use in further research in this area may provide an objective assessment of motor changes. Second, the finding that the fine motor composite of the BOTMP correlated significantly with 14 of the 18 SCSIT tests suggests that this could be a useful screening test in identifying those children with possible sensory integrative dysfunction and requiring occupational therapy.

REFERENCES
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