Basic Gross Motor Assessment: Tool for Use with Children Having Minor Motor Dysfunction
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Basic Gross Motor Assessment

Tool for Use with Children Having Minor Motor Dysfunction

JEANNE E. HUGHES, MS
and ANN RILEY, MA

Children with minor motor problems are often referred for evaluation of these problems to physical therapists who work in educational environments. Measures that therapists use to assess seriously disabled children are often inappropriate for these children. The Basic Gross Motor Assessment was developed after analyzing research on minor motor dysfunction. Standard procedures were outlined and a sample of 1,260 randomly selected children aged 5 years 6 months to 12 years 5 months served for norming purposes. Validity and reliability studies were completed with an additional 285 subjects. The Basic Gross Motor Assessment is presented as a useful tool for evaluating minor motor problems in children and identifying those children who require further physical therapy assessment and perhaps direct treatment.

Key Words: Motor skills, Evaluation studies, Child development, Physical therapy.

Physical therapists who work with children in clinics and in educational environments are uniquely prepared to evaluate the motor performance of physically handicapped and developmentally disabled children. Postural reflexes, joint range of motion, muscle strength, gait, posture, and ability to perform activities of daily living are among the areas traditionally assessed by therapists. There is a group of children often enrolled in special education programs, however, who do not have specifically diagnosed physical handicaps and for whom the above-listed measures are not fully appropriate. Children in this group walk, run, and play and seem to perform reasonably well, but they are referred to the physical therapist for evaluation because of clumsiness and inefficient motor behaviors. Careful observation reveals a lack of motor skill or minor motor dysfunction in these children compared to normally functioning children. An evaluation of the motor difficulties of these children is necessary but should begin at a higher level of performance than that expected of the more seriously disabled child.

PROBLEM

Since the late 1960s, large numbers of children with minor motor dysfunction have been referred to our motor development program in the Denver Public Schools. This situation led to our comprehensive search for measurement devices to assess these children's motor problems. Criteria used to evaluate dozens of published tests included 1) age norms for children 6 to 12 years of age, 2) standardized administration procedures and directions, 3) a scoring system that quantified the quality of movement, 4) validity and reliability data, 5) a minimum of equipment, and 6) reasonable administration time. In addition, we sought a measurement tool that might discriminate between children whose motor aberrations were probably due to experiential lags and those whose performance indicated a need for medical referral, physical therapy evaluation, and possible treatment. Because no one test met these requirements, we decided to develop a test that would yield the desired information about a child's motor performance. The resulting test is now known as the Basic Gross Motor Assessment, BGMA.1 The purpose

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of this paper is to describe the development of this measure.

REVIEW OF LITERATURE

Essential to the development of the BGMA was a description of the nature of the disability to be evaluated. An investigation of the theoretical positions, definitions, and terminology associated with motor development and dysfunction made apparent the great breadth of the topic of minor motor dysfunction. The massive amount of literature on this subject has been generated by professionals in several different areas of medicine, education, and psychology. Our major concerns were to describe the types of children for whom the BGMA would be most appropriate, to define the concept of gross motor abilities, and to determine a rationale for choosing tasks to be included in the assessment.

The available evidence indicates that educable and trainable mentally retarded children often lag behind children of normal intelligence in motor development and performance and that these defects range from minor to severe. In addition, there are children with motor problems in the absence of mental retardation or physical disability who are described as having developmental clumsiness, perceptual motor problems, or sensory integrative difficulties. The term clumsy is imprecise and possibly pejorative, but it is used by many concerned with children having minor motor dysfunction.

Gubbay made a detailed study of the clumsy child syndrome, including the range of possible causes. Two distinct approaches to defining the subject were identified in his careful review of relevant literature. Some writers, he found, view the clumsy child syndrome as a precise entity that may be unrelated to intelligence, behavior, or learning. Others have regarded developmental clumsiness as one characteristic of minimal cerebral damage, grouping it with hyperkinesis, emotional lability, specific learning disability, perceptual problems, and equivocal neu­logic signs.

The concept that minor motor dysfunction is one condition often found in children having learning disabilities can be traced to the classic studies by Strauss and Lehtinen, who described behaviors, including clumsiness, in children with a history of brain damage. A number of approaches to the remediation of learning disability place emphasis on visual-motor and perceptual-motor evaluation and programming. Theories regarding the relationship between efficient motor performance and academic achievement and claims for the efficacy of various treatment methods have been subjected to considerable scrutiny and criticism. We have chosen to focus on the nature of a child’s gross motor problems rather than investigate these controversies.

One reason for the evaluation of motor performance problems and development of remedial programs for children having minor motor dysfunction may be found in the fact that these children are vulnerable to the social-emotional pressures of family and peers. This problem is summarized by Stewart and Old’s comment that “the cruelest problem facing an ungainly child is social failure.”

Gross motor development has been operationally defined by Hoskins and Squires as the sequential integration of automatic, stereotyped, reflex phenomena leading to the emergence of voluntary, discrete, nonobligating motor behaviors concerned with posture and locomotion. Elaboration of the gross motor concept by Arnheim and associates details a universe of 45 gross motor behaviors. The movements listed range from crawling and walking to catching and throwing.

A theory important to the development of the BGMA and supported by a number of studies is that essential gross motor abilities develop during the first five years of life and stabilize at the end of the fifth year.

The neurodevelopmental techniques developed by the Bobaths for the treatment of cerebral palsy patients derive in part from the development of normal children. The Bobaths state that the normally developing child has good control of his balance by about the age of five years. He can jump, play games, and coordinate selective and precise movements of his hands for manual skills. From this age, motor development slows down and no drastic or rapid changes take place, although coordination and skills continue to improve during the rest of school life.

The five- to six-year period in a child’s development is regarded by Williams as the end of a major growth epoch. Although many refinements in gross motor behavior are likely to occur in the years that follow, by the end of the fifth year the child can perform most simple gross motor patterns with nearly as much fluency as a skilled adult can.

The remainder of this paper will present three studies conducted during the development of the BGMA. The first study was done to establish administration procedures and age norms for the various tasks. The second study collected various estimates of reliability of the BGMA. Documenting the validity of the BGMA was the purpose of the final study.

STUDY 1

The BGMA was developed to evaluate gross motor performance of children aged 5 years 6 months to 12
years 5 months who seem to have motor problems. We hypothesized that if basic gross motor abilities stabilize during the fifth year, as reported in the preceding studies, then the test should contain tasks representative of gross motor abilities normally mastered by this age. Further, these basic tasks should be accomplished with ease by normal children from kindergarten through grade six.

Method

The first step in developing the BGMA was to choose the tasks to be included and decide how to score them. In addition to the examination of the literature previously described, the process of item selection included extensive observations of the motor performances of both regular and special education children in physical education classes at all grade levels. Considerable attention was also given to these children during their participation in spontaneous play. After specific tasks were chosen for the test, children of various ages were videotaped as they performed these tasks. These tapes were carefully reviewed to determine the elements of good performance.

Although the quality of any individual's motor performance will vary from one observation to the next, Safrit argues that aspects of good performance can be defined and measured accurately. In her model, the most important components of the ability are identified and a scale is then devised to measure performance against the components. An example of this method is the judging of gymnastic performance. Zausmer has suggested that information about how a child with a motor disturbance performs a task is more important than an indication of whether he can or cannot do the task.

Following the concept of measuring performance quality, we devised a system for quantifying performance based on deviations from good performance. Good performance was defined for each of the tasks later selected and given a score of 3. Each deviation observed in a child's performance of a task subtracted one point from the score for that task. This resulted in the following possible point scores for each item: 3 = good (no deviations), 2 = fair (one deviation), 1 = poor (two deviations), 0 = (unable to perform task or more than two deviations).

To assist in defining the quality of gross motor performance and the selection of criteria for scoring, six well-known tests containing gross motor tasks were reviewed. These tests were the Southern California Perceptual Motor Test, Ayres; the Six Category Gross Motor Test, Cratty and Martin; The Purdue Perceptual-Motor Survey, Roach and Ke-
Ages of Subjects

<table>
<thead>
<tr>
<th>Group</th>
<th>6-year-olds</th>
<th>7-year-olds</th>
<th>8-year-olds</th>
<th>9-year-olds</th>
<th>10-year-olds</th>
<th>11-year-olds</th>
<th>12-year-olds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>62.83</td>
<td>84.78</td>
<td>109.01</td>
<td>134.20</td>
<td>145.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls</td>
<td>72.94</td>
<td>84.92</td>
<td>109.04</td>
<td>133.80</td>
<td>145.25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Task 8,** yo-yo. This was a novel task that used a plastic container with a handle, to which a ball was attached by a string. The size of the container and the weight of the ball were changed according to the child's age. The child was required to swing the ball on the string, toss it, and catch it in the container.

**Task 9,** ball handling. Catching, throwing, and bouncing or dribbling a ball were included. Several aspects of the task were varied according to the child's age: size of the ball, distance between the examiner throwing the ball and the child catching it, and bounce or dribble of the ball. Although experience is necessary for ball-handling skills, school-aged children in nearly every culture have had some experience with ball play. Skill involved in control of the ball was considered to reveal motor dysfunction quite clearly.

The second step in this study was to determine the typical performance of 6- to 12-year-old children on the nine tasks described above. To ensure standardized administration of the BGMA, the area to be designated for testing, equipment to be used, and specific directions to the child were detailed.

A sample of 1,260 children was selected from the population of children in Denver Public Schools. This population was stratified by race and socioeconomic status, sex, and grade level. First, the city was divided into four quadrants that contained different racial and socioeconomic status groups. From these four quadrants, 18 schools were selected, so as to provide equal representation of racial and socioeconomic status groups. Five boys and five girls from each of seven grades (kindergarten through sixth grade) were

**Table 2**

<table>
<thead>
<tr>
<th>n</th>
<th>( \bar{x} ) Total Score</th>
<th>s</th>
<th>SE</th>
<th>t</th>
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<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>90</td>
<td>32.7</td>
<td>5.3</td>
<td>2.36</td>
</tr>
<tr>
<td>Girls</td>
<td>90</td>
<td>32.9</td>
<td>4.6</td>
<td>2.17</td>
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<tr>
<td>7-year-olds</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>90</td>
<td>46.9</td>
<td>6.1</td>
<td>3.09</td>
</tr>
<tr>
<td>Girls</td>
<td>90</td>
<td>47.3</td>
<td>5.7</td>
<td>3.04</td>
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<tr>
<td>8-year-olds</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>90</td>
<td>49.1</td>
<td>6.8</td>
<td>2.89</td>
</tr>
<tr>
<td>Girls</td>
<td>90</td>
<td>48.6</td>
<td>5.0</td>
<td>2.77</td>
</tr>
<tr>
<td>9-year-olds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>90</td>
<td>50.2</td>
<td>4.9</td>
<td>2.65</td>
</tr>
<tr>
<td>Girls</td>
<td>90</td>
<td>49.6</td>
<td>5.1</td>
<td>2.78</td>
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<td>10-year-olds</td>
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<tr>
<td>Boys</td>
<td>90</td>
<td>51.5</td>
<td>4.2</td>
<td>2.21</td>
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<tr>
<td>Girls</td>
<td>90</td>
<td>49.7</td>
<td>4.7</td>
<td>2.73</td>
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<tr>
<td>11-year-olds</td>
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<td></td>
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<tr>
<td>Boys</td>
<td>90</td>
<td>52.5</td>
<td>3.8</td>
<td>1.89</td>
</tr>
<tr>
<td>Girls</td>
<td>90</td>
<td>51.2</td>
<td>4.8</td>
<td>2.33</td>
</tr>
<tr>
<td>12-year-olds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>90</td>
<td>52.6</td>
<td>3.8</td>
<td>2.17</td>
</tr>
<tr>
<td>Girls</td>
<td>90</td>
<td>53.3</td>
<td>2.6</td>
<td>1.94</td>
</tr>
</tbody>
</table>

*\( p < .01. \)
*\( p < .05. \)
nine BGMA tasks were administered to each child in the sample are reported in Table 1. The mean and standard deviation of the ages of the children in the sample was drawn. The study was conducted for four months during the second semester of the school year. Children in special education had been excluded before the sample was drawn. The mean score for each of the nine tasks was calculated for each age group. Based on these results, two minor changes were made in the assessment. No group received a mean score above 2.64 for Task 2—standing balance with eyes closed—although the scores did improve from 1.84 for the 7-year-olds to 2.64 for the 12-year-olds. When compared to mean scores for the other tasks at each age level, this task seemed difficult for most of the subjects and was dropped from the final battery on the assumption that if standing balance with eyes closed was difficult for normal children then it was not a good discriminating task for identification of children having motor problems.

Three tasks proved to be too difficult for the average six-year-old children and these were eliminated for this age group only. These tasks were 1) standing balance with eyes open and arms crossed over the chest, 2) stride jump, and 3) yo-yo.

The descriptive statistics of total scores for each age group and the results of a t test comparing boys' and girls' scores are presented in Table 2. In the total scores, the only sex differences that were significant \( p < .05 \) were for the 10- and 11-year-olds in favor of boys. Subtest scores were also analyzed, using a t test comparison of boys' and girls' scores. Eleven-year-old boys were better at catching and throwing the ball than 11-year-old girls were; girls at all ages were better at skipping than boys were. These findings should be considered in test interpretation.

In addition to the deviations for each specific task, conditions and behaviors of a more general nature were observed with some children in the sample. Of these, 32 are listed on the BGMA protocols. The examiner can use this list to help structure observations of the child's behavior and account for some conditions during the administration of the test. The list is also used in determining the need for further physical therapy evaluation. Examples of conditions or behaviors that were noted during the children's participation in the assessment included 1) unusual size for age, particularly obesity, 2) poor posture, and 3) tendency to switch hands during the execution of a task.

Discussion

Three major conclusions were drawn from this study. First, although normal six-year-olds performed well on most of the tasks selected, three tasks were difficult for some, indicating that we had chosen tasks that were harder than anticipated. Second, standing balance with eyes closed is probably not a task that discriminates between aberrant and normal motor performance. Third, a number of conditions and behaviors need to be considered in assessing motor performance.

STUDY 2

In addition to age norms and standardized procedures, we wished to estimate the reliability of the BGMA. Three estimates were obtained: one comparing the same children's scores at different times, one comparing several raters' scores of the same children's performances, and the last comparing the items for internal consistency.

Method

Inasmuch as motor task performance is not exactly the same on all occasions, the first source of variability was that within the performers themselves. A coefficient of stability was estimated using a test-retest procedure. The subjects were 48 students chosen from special education and physical education classes. The BGMA was administered to these subjects twice, with a two-day interval between sessions.

The scoring of the BGMA is also dependent upon the consistency with which different raters observed performance. The consistency of different raters' using the BGMA was determined using a measure of interrater reliability. The BGMA was administered to 10 children, whose performance was observed and rated by five different professionals: a kindergarten teacher, a special education teacher, a physical education teacher, an occupational therapist, and a physical therapist. The subjects were chosen from a population of children enrolled in a regular physical education class who had been referred by their teacher as having possible motor performance difficulties.

The final estimate of reliability was calculated using all the data from the original norming group (1,260 subjects). An internal consistency coefficient was calculated for each age level.

Results

The results of the reliability study are summarized in Table 3. The test-retest reliability coefficient sup-
The reliability of subtest scores will be much higher than the reliabilities of individual children, high reliability is important. All of the reliability estimates calculated for the BGMA are high enough to warrant confidence in the obtained scores. Total scores were used in all of the calculations. The reliability of subtest scores will be much lower, and therefore the scores on single subtests should never be used in isolation to make decisions about children's needs.

**STUDY 3**

One of the most neglected aspects of test construction is the determination of validity. Validity, unlike reliability, is usually not easily or directly estimable. During the development of the BGMA, a three-step study was conducted to provide evidence concerning the content, construct, and concurrent validity of the instrument.

**Method**

**Content Validity.** The tasks chosen to represent the universe defined as gross motor performance did not include physical fitness, fine motor, or sports skill tasks. The BGMA was presented to a panel of six professionals for review and for suggestions for task improvement before the tests were administered to the norming sample population.

**Construct Validity.** A construct is described as a theoretical idea developed to explain and to organize some aspects of existing knowledge. In the review of literature, much evidence was found supporting the construct of gross motor abilities. Our investigation of construct validity involved two procedures. We predicted that special education children referred by their teachers for evaluation of suspected motor difficulties would not perform as well as the children in the sample drawn for norming purposes. Further, we predicted that certain tasks in the BGMA would be related because of the communality of skills required.

To investigate the first prediction, BGMA scores were compared for 81 special education and 81 age-matched children selected randomly from the appropriate age group of the norming study sample. The children ranged in age from 6 to 12 years old. The special education children were from classes for educable mentally retarded, learning disabled, and emotionally disturbed children. An additional group of trainable mentally retarded children had also been referred, but only one child in this group of 16 pupils was able to score even 50 percent of the expected average score. In fact, motor responses of these children on the BGMA tasks with the quality criteria were virtually unscorable, which led to the conclusion that the BGMA is probably inappropriate for use with most severely retarded children.

The comparison between the special education and normal children's scores at each grade level was done using a t test for the mean total scores of each group.

The second analysis of data to confirm the construct of gross motor ability was a factor analysis. Factor analysis is a statistical procedure used to determine 1) how many factors (groupings) are needed to account for intercorrelations among a set of test scores, 2) which factors determine performance on each test, and 3) how much variance in test scores is accounted for by the factors. Tests that share common variance thus measure the same factor. The propor-

### TABLE 3

**Results of BGMA Reliability Studies**

<table>
<thead>
<tr>
<th>Type of Reliability</th>
<th>Calculation Used</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stability</td>
<td>Pearson r</td>
<td>.97 (n = 48, p &lt; .001)</td>
</tr>
<tr>
<td>Interrater</td>
<td>Hoyt</td>
<td>.97 (n = 5, p &lt; .001)</td>
</tr>
<tr>
<td>Internal consistency</td>
<td>Hoyt</td>
<td>.71 (n = 180, p &lt; .01)</td>
</tr>
</tbody>
</table>

Supports the conclusion that children's performance does not vary significantly from day to day.

The interrater reliability was estimated at .994. The reliability of one rater was calculated using the Spearman-Brown formula to adjust the reliability given five raters. This estimate was .97 (Tab. 3).

The internal consistency coefficient is the median value obtained. These were calculated for each age level and ranged from .59 to .79. The estimates of internal consistency are considerably lower than the other reliability coefficients. This was anticipated for two reasons. First, the domain of gross motor skills is probably heterogeneous. A child with good balance may or may not have good ball-handling skills. This is supported in the literature on specificity of motor skills. Secondly, the reliabilities are probably attenuated, particularly at the upper grade levels because of a ceiling effect. The BGMA was meant to identify children with motor dysfunction and place them in order in terms of severity. It will not discriminate between an outstanding athlete and a normal child. Most normal children can perform the tasks well enough to get nearly perfect scores. The result is a negatively skewed distribution that lowers the reliability estimate. An additional study is currently being conducted with special education students to estimate the test's reliability with this population.

**Discussion**

When tests are used to make decisions about individual children, high reliability is important. All of the reliability estimates calculated for the BGMA are high enough to warrant confidence in the obtained scores. Total scores were used in all of the calculations. The reliability of subtest scores will be much lower, and therefore the scores on single subtests should never be used in isolation to make decisions about children's needs.
The search for factors was initiated using the SPSS Factor program. 24 The principal factoring method with iterations was used, and the initial factor solution was rotated using Varimax criterion to achieve simple structure. Separate factor analyses were performed for the seven age groups. When highly similar factor structures were found for the individual age groups of 7 through 12 years, the data for those 1,080 children were pooled to derive an overall principal factor structure.

Concurrent Validity. The third type of validity that was considered was concurrent validity, which indicates the extent to which a test may be used to estimate an individual's current performance on a selected criterion.

The first estimate of concurrent validity was a comparison of physical education teachers' ratings of children's class performance with scores of the same children on the BGMA. One girl and one boy at each grade level, one through six, were chosen at random from the class lists of teachers in the 12 schools where teachers had agreed to participate in the study. The teachers then rated the children from 5 (high) to 1 (low) on their ability in gymnastics, soccer, ball handling, physical fitness tasks, and agility. The same

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
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<tbody>
<tr>
<td>6</td>
<td>11</td>
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<td>11</td>
<td>33.36</td>
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<td></td>
<td>8</td>
<td>53.62</td>
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* p < .01.
TABLE 6
Correlations Between Teacher Observations and BGMA Total Scores

<table>
<thead>
<tr>
<th>Grade 1</th>
<th>Gymnastics Observation</th>
<th>Soccer Observation</th>
<th>Agility</th>
<th>Rhythm</th>
<th>Ball</th>
<th>Physical Fitness Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-year-olds</td>
<td>.59&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.63&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.55&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.42&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.60&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.56&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Grade 2</td>
<td>8-year-olds</td>
<td>.46&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.60&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.41&lt;sup&gt;a&lt;/sup&gt;</td>
<td>NS</td>
<td>.64&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Grade 3</td>
<td>9-year-olds</td>
<td>.64&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.70&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.72&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.72&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.64&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Grade 4</td>
<td>10-year-olds</td>
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<td>.67&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.56&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>.54&lt;sup&gt;b&lt;/sup&gt;</td>
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<td>Grade 5</td>
<td>11-year-olds</td>
<td>.47&lt;sup&gt;b&lt;/sup&gt;</td>
<td>NS</td>
<td>.56&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.69&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.43&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Grade 6</td>
<td>12-year-olds</td>
<td>.79&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.60&lt;sup&gt;c&lt;/sup&gt;</td>
<td>.47&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.49&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.44&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> p < 0.5 and >.01.
<sup>b</sup> p < .01 and >.001.
<sup>c</sup> p < .001.

children were also given the BGMA. The total scores on the BGMA were correlated with each of the teacher’s ratings.

A second estimate of concurrent validity was made from the data previously collected from the interrater reliability. The mean scores given by the five raters were tested for significant difference using a repeated-measures ANOVA.

Results

Content Validity. The suggestions and comments made by the professional reviewers were incorporated into the final test items.

Construct Validity. The comparison between the special education and norming sample children resulted in significant differences in means favoring the normal children at each level (Tab. 4).

The factor analysis resulted in seven factors with eigenvalues of 1.0 or greater and together accounted for 76 percent of the total variance. Inspection of the data shows seven readily interpretable factors for 7- to 12-year-old children (Tab. 5). The group of six-year-olds had the same general factor structure except for static balance with eyes closed, a task that had been eliminated from the battery for this age group. The seven factors were named and defined as follows:

Factor 1: Static balance, eyes open—equilibrium reactions that maintain the body in an upright position but without movement through space. Sensory input is primarily proprioceptive, visual, and vestibular.

Factor 2: Elementary ball handling—ability to organize perceptual motor responses required for simple functions of ball control.

Factor 3: Static balance, eyes closed—equilibrium reactions as in Factor 1 except without visual input.

Factor 4: Leg strength and balance—incorporation of strength to elevate body on one foot with ability to maintain balance on same foot when landing and while making rhythmical forward progression.

Factor 5: Object control—ability to initiate smooth, rhythmical hand and arm movements to control an object moving through a restricted range, using visual and proprioceptive feedback.

Factor 6: Aiming—ability to focus on a target visually and to project an object through space with proper force, accuracy, and coordination to hit a target.

Factor 7: Dynamic balance—postural stability in motion, with equilibrium control constantly keeping body center of gravity over changing base of support in movement.

Task 3, stride jump, did not correlate with any other task in the BGMA group and thus did not emerge as a factor. However, the task was retained in the assessment for its value in discrimination of motor problems.

Concurrent Validity. The results of comparison between BGMA scores and teacher ratings for 7- to 12-year-olds are reported in Table 6.
The correlations are significant in 33 of 36 cases. The repeated-measures ANOVA of the interrater reliability data provides no reason to believe that the total scores given by the five raters were different in any important way \((F = 1.375, \text{df} = 4, p < .26)\). Although they came from different professional disciplines, the BGMA structured the raters’ observations so that the scores they gave were essentially the same.

**Discussion**

The evidence of the factor structure supports the construct validity of the BGMA. The factors were predictable and interpretable from the theory upon which the test was based.

Using the scores on the BGMA, children having minor motor dysfunction can be identified from normal children. The special education children in the study were expected to score lower because of the motor problems generally associated with other handicaps and because this group had been referred specifically for evaluation of suspected motor difficulties. This confirmation of the expected differences between the groups also supports the construct validity of the BGMA.

The evidence for concurrent validity is also supportive. The scores on the BGMA correspond very well to the observations made by the physical education teachers, and different raters gave approximately the same score to children on the BGMA.

**CONCLUSIONS**

Physical therapists are being employed or contracted to work in educational environments in ever-increasing numbers since the passage of Public Law 94-142. Handicapped children from several categories of special education who have minor motor dysfunction are being referred to these therapists for assessment of gross motor performance. We believe the BGMA meets the requirements of a good assessment tool and can be used with confidence for making program decisions for these children.

**Acknowledgment.** We wish to acknowledge the cooperation of the children, teachers, and administrators of the Denver Public Schools in making this project possible.

**REFERENCES**

5. Ayres AJ: Sensory Integration and Learning Disorders. Los Angeles, CA, Western Psychological Services, 1972, pp 1–12