The Miller Assessment for Preschoolers: Clinical Use With Children With Developmental Delays

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Key Words: child development disorders • developmental screening • tests, by title

In this pilot study, we investigated the clinical use of the Miller Assessment for Preschoolers (MAP) (Miller, 1982) with a sample of children with suspected or confirmed developmental delays. A retrospective chart audit was performed for 95 subjects, 30 girls and 65 boys, 34 to 68 months of age. Clinically related diagnoses were classified into six medical/developmental groups and a no-diagnosis group. When an analysis of variance was used to compare the six medical/developmental groups with the no-diagnosis group, some of the MAP score patterns differed significantly (p < .01). These score patterns provide preliminary evidence for the MAP’s effectiveness in screening children with developmental delays.

The need for reliable and valid tests for the assessment of pre-school-age children at risk for developmental dysfunction has been identified by authors in numerous disciplines, including education (Brooks-Gunn & Lewis, 1983; Lewko, 1976), medicine (Farber, Shapiro, Palmer, & Capute, 1985), and occupational therapy (DeGangi, Berk, & Larsen, 1980; Hasselkus & Safrit, 1976; Israellevitz, Fisher, & Bundy, 1985). Few standardized instruments for this age group address the sensory, neurodevelopmental, motor, and perceptual aspects of behavior, which are of concern to the occupational therapist.

The Miller Assessment for Preschoolers (MAP) (Miller, 1982) is a standardized instrument designed (a) to identify preschool children who are likely to experience later school-related problems (MAP Screening) and (b) to provide a comprehensive clinical framework to help define a child’s strengths and weaknesses and indications for remediation (MAP Comprehensive). The core test consists of 27 items within five performance indexes: Foundations, Coordination, Verbal (language skills), Nonverbal (reasoning skills), and Complex Tasks. A child’s total MAP score can fall into one of three score bands: red equals at risk (1% to 5% score); yellow equals possibly at risk (6% to 25% score); and green equals no problem (26% score and above). The test construction and standardization adhered to accepted psychometric principles, including a random stratified sampling of a large number of normal subjects with representative distributions for sex, age, geographic region of the United States, and socioeconomic status (Benson & Clark, 1982).

For the standardization, in addition to the 1,204 normal children in the normative sample, the MAP was also administered to 90 children with functional delays in perceptual, language, or behavioral development. Children with diagnosed cerebral palsy, autism, or mental retardation were excluded from the sample. The MAP scores identified 50% of the delayed group as functioning at or below the 5th percentile (at risk) and another 25% as functioning in the 6th to 25th percentile (possibly at risk). The manual does not clearly specify information regarding age, sex, race, type and extent of delay, and criteria for inclusion in the functional delay group. Also, data that compared scores and score patterns of the functional delay group with the normative sample were not provided. DeGangi (1983) stated that “without this information,
it is difficult to determine the effectiveness of the MAP in screening children with functional delays" (p. 408).

Several predictive validity studies have been completed recently (Cohn, 1986; Lemerand, 1985, 1988; Miller, 1986; Miller, Lemerand, & Cohn, 1987). These studies provided preliminary support for the MAP's ability to differentiate between academic "problem" and "no problem" children and support for the 5% and 25% cutoff points. The 5% cutoff point effectively identified children requiring special education, whereas the 25% cutoff point identified children with severe to mild problems.

Miller (1986, 1988) reported detailed classification analysis results including sensitivity and specificity of the MAP for 12 variables. The overall classification accuracy was (a) 90% at the 25% cutoff point with a false-positive rate of 8.4% and a false-negative rate of 4.2% and (b) 77% at the 5% cutoff point with a false-positive rate of 2.4% and a false-negative rate of 7.7%. Thus, critical opinion and research evidence to date suggest that the MAP is psychometrically well developed and clinically useful.

In follow-up predictive studies by Miller (1986, 1987), 29 of the original 90 at-risk children were available for testing. Data for these children were combined with data for the 309 normal children for analysis. Thus, a comparison of scores and score patterns for the at-risk group with those for the normative sample is still unavailable.

Although the MAP was originally designed as a screening instrument to identify children with mild to moderate preacademic problems, clinicians have found it to be a useful adjunct to assessment and treatment planning for children with developmental delays or with known developmental disorders (Denning & Mayberry, 1987; Slaton, 1985). The MAP is being used clinically in this manner by a majority of pediatric facilities in British Columbia (Pediatric Occupational Therapy Directors Group, personal communication, 1986).

For these reasons and because it is a new test, additional studies, besides those conducted for test standardization, are needed to determine the MAP's usefulness in the clinical setting. If clinicians are going to use the MAP with children with known developmental delays or disorders, then the test's validity with these groups must be established. The objective of this pilot study, therefore, was to examine the patterns of MAP scores in relation to medical/developmental diagnostic categories among pre-school age children referred to a tertiary care hospital for the assessment of developmental problems.

### Study Design and Method

#### Subjects

The study subjects were identified from the files of the Occupational Therapy Department at British Columbia Children's Hospital in Vancouver. The total available sample consisted of 95 subjects—30 girls and 65 boys—ranging in age from 34 months to 68 months (M age = 55.2 months, SD = 8.3 months). Each child required medical tests, and staff occupational therapists routinely administered the MAP using standardized procedures.

#### Procedure

The medical charts were reviewed, and each child's age, sex, MAP score band for each of the 27 items, five index scores, total score, reason for referral, and medical/developmental diagnosis were recorded. On the basis of a primary medical or developmental diagnosis, each child was assigned to one of seven groups: speech-language problems (n = 17), output problems (n = 13), speech-language output problems (n = 9), developmental delay (n = 18), neurological disorders with developmental delay (n = 14), psychiatric diagnoses (n = 11), and no diagnosis (n = 13).

The children in the speech-language problems group had speech problems, language problems, or both. The children in the output problems group had fine motor, gross motor, visuomotor, eye-hand coordination, or articulation delays or disorders. Children with output problems as well as speech or language problems constituted the speech-language output problem group. The developmental delay group contained all children so identified as well as children whose IQ scores were below average. The neurological disorders group had developmental delay as well as children with such conditions as seizure disorder, neurofibromatosis, postmeningitis, hydrocephalus, Kinsbourne syndrome, hyperactivity, attention deficit disorder, cerebral dysfunction, and central processing disorder. The children in the psychiatric diagnoses group had all been referred to the hospital's child psychiatry unit for various behavioral problems.

The no-diagnosis group comprised those children whose MAP total scores were within normal limits and for whom no medical/developmental diagnosis was made for the particular assessment period studied. The children in this group (a) were screened because of concerns expressed by physicians, public health nurses, or parents regarding the child's development or (b) were considered at risk for developmental problems because of previously diagnosed conditions such as prematurity, failure to thrive in infancy, or gastroesophageal reflux. The no-
Table 1
Statistical Analysis of Subjects’ Scores on the Miller Assessment for Preschoolers* (N = 95)

<table>
<thead>
<tr>
<th>Test Indexes</th>
<th>Minimum (%)</th>
<th>Maximum (%)</th>
<th>M (%)</th>
<th>SD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total score</td>
<td>1</td>
<td>83</td>
<td>20.9</td>
<td>19.1</td>
</tr>
<tr>
<td>Foundations index</td>
<td>1</td>
<td>99</td>
<td>32.1</td>
<td>26.5</td>
</tr>
<tr>
<td>Coordination index</td>
<td>1</td>
<td>99</td>
<td>27.9</td>
<td>24.2</td>
</tr>
<tr>
<td>Verbal index</td>
<td>1</td>
<td>99</td>
<td>30.2</td>
<td>30.3</td>
</tr>
<tr>
<td>Nonverbal index</td>
<td>1</td>
<td>99</td>
<td>50.9</td>
<td>32.6</td>
</tr>
<tr>
<td>Complex tasks index</td>
<td>1</td>
<td>99</td>
<td>29.0</td>
<td>29.3</td>
</tr>
</tbody>
</table>

* (Miller, 1982).

A diagnosis group served as the control group for the subsequent analyses.

An expert panel made up of three occupational therapists and a medical records librarian validated each group’s composition and label. We examined the relationship between MAP scores and diagnostic category by comparing the no-diagnosis group with the six medical/developmental diagnostic groups using analysis of variance (ANOVA).

Results

Preliminary analyses ruled out possible confounding factors due to age or sex. A one-way ANOVA was performed to identify any age differences between the seven groups. No statistically significant difference emerged [F(6, 94) = 1.28, p = .28]. A chi-square analysis revealed no significant sex effect (X^2 = 3.71, p = .72). The level of significance was set at p = <.05 for these and subsequent comparisons.

The distribution of the index and total scores spanned the possible score range, 1% to 99%, whereas the total score range was narrower, 1% to 83%. The mean scores tended to be low (see Table 1). All of the index scores were skewed—most were in the lower percentages.

A univariate one-way ANOVA was used to compare the differences between the no-diagnosis group and each of the six medical/developmental diagnostic groups on the total and index scores. The means and standard deviations for each group as well as the F values of the ANOVA are presented in Table 2. All of the F values were significant at the p < .01 level.

A comparison of each of the problem groups with the no-diagnosis group yielded the following results:

- The speech-language problems group scored significantly lower on the Verbal index and on the total score.
- The output problems group scored significantly lower on the Verbal and Nonverbal indexes as well as on the total score.
- The speech-language output problems group scored significantly lower on the Verbal, Nonverbal, Coordination, and Foundations indexes as well as on the total score.
- The developmental delay and neurological disorders with developmental delay groups...

Table 2
Statistical Analysis of Subjects’ Scores on the Miller Assessment for Preschoolers* by Diagnostic Category (N = 95)

<table>
<thead>
<tr>
<th>Variable</th>
<th>No Diagnosis (n = 13)</th>
<th>Speech-Language Problems (n = 17)</th>
<th>Output Problems (n = 13)</th>
<th>Speech Language Problems (n = 9)</th>
<th>Developmental Delay (n = 18)</th>
<th>Neurological Disorders With Developmental Delay (n = 14)</th>
<th>Psychiatric Diagnoses (n = 11)</th>
<th>ANOVA** (F(6, 94))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>43.3</td>
<td>26.8*</td>
<td>21.5*</td>
<td>7.7*</td>
<td>7.2*</td>
<td>10.2*</td>
<td>31.2</td>
<td>11.1</td>
</tr>
<tr>
<td>M</td>
<td>21.7</td>
<td>14.5</td>
<td>12.6</td>
<td>8.0</td>
<td>7.0</td>
<td>8.1</td>
<td>25.0</td>
<td>5.5</td>
</tr>
<tr>
<td>SD</td>
<td>48.2</td>
<td>42.8</td>
<td>46.9</td>
<td>14.8*</td>
<td>15.9*</td>
<td>19.5*</td>
<td>35.7</td>
<td>3.6</td>
</tr>
<tr>
<td>Coordination index</td>
<td>28.4</td>
<td>24.2</td>
<td>30.8</td>
<td>15.1</td>
<td>15.3</td>
<td>13.2</td>
<td>30.6</td>
<td>5.6</td>
</tr>
<tr>
<td>M</td>
<td>40.6</td>
<td>43.9</td>
<td>30.5</td>
<td>21.2*</td>
<td>17.2*</td>
<td>18.1*</td>
<td>20.8*</td>
<td>44.3</td>
</tr>
<tr>
<td>SD</td>
<td>29.9</td>
<td>27.6</td>
<td>16.0</td>
<td>18.0</td>
<td>22.8</td>
<td>17.8</td>
<td>15.3</td>
<td>29.8</td>
</tr>
<tr>
<td>Verbal index</td>
<td>61.5</td>
<td>21.0*</td>
<td>38.3*</td>
<td>11.7*</td>
<td>20.0*</td>
<td>19.1*</td>
<td>44.3</td>
<td>5.0</td>
</tr>
<tr>
<td>M</td>
<td>34.0</td>
<td>24.2</td>
<td>31.4</td>
<td>15.3</td>
<td>22.8</td>
<td>24.3</td>
<td>29.8</td>
<td>3.0</td>
</tr>
<tr>
<td>SD</td>
<td>76.0</td>
<td>57.1</td>
<td>42.1*</td>
<td>42.9*</td>
<td>33.2*</td>
<td>48.6*</td>
<td>60.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Nonverbal index</td>
<td>26.6</td>
<td>31.7</td>
<td>35.3</td>
<td>28.5</td>
<td>30.2</td>
<td>32.1</td>
<td>28.1</td>
<td>0.5</td>
</tr>
<tr>
<td>M</td>
<td>34.5</td>
<td>49.2</td>
<td>27.7</td>
<td>16.7</td>
<td>12.5*</td>
<td>14.2*</td>
<td>50.9</td>
<td>40.9</td>
</tr>
<tr>
<td>SD</td>
<td>24.5</td>
<td>32.3</td>
<td>27.5</td>
<td>17.0</td>
<td>16.8</td>
<td>15.3</td>
<td>40.9</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Note. ANOVA = analysis of variance.

* (Miller, 1982).

** Significant at p < .01.
scored significantly lower on all of the MAP scores.

- The psychiatric diagnoses group scored significantly lower on the Coordination index.

Post hoc comparisons were done with paired t tests. Because of the number of paired comparisons involved (126), the alpha level was adjusted from .05 to .01. Unlike most post hoc procedures, this procedure does not assume independence across groups (Snedecor & Cochran, 1967). The comparisons were examined to identify significant differences among the six medical/developmental groups. The results were as follows:

- **Total score**—The speech-language problems and psychiatric diagnoses groups' mean scores were significantly higher than those of the speech-language output problems, developmental delay, and neurological disorders with developmental delay groups. The output problems group scored significantly higher than the speech-language output problems, developmental delay, and neurological disorders with developmental delay groups.

- **Foundations index**—The speech-language problems and output problems groups scored significantly higher than the speech-language output problems, developmental delay, and neurological disorders with developmental delay groups.

- **Coordination index**—The speech-language problems group scored significantly higher than the developmental delay, neurological disorders with developmental delay groups.

- **Verbal index**—The psychiatric diagnoses group scored significantly higher than the speech-language output problems group.

- **Nonverbal index**—No significant differences occurred.

- **Complex Tasks index**—The speech-language problems and psychiatric diagnoses groups scored significantly higher than the speech-language output problems, developmental delay, and neurological disorders with developmental delay groups.

Thus, general patterns of score differences did emerge in this sample.

Because this was an exploratory investigation with small numbers in some groups and a skewed score distribution, we performed nonparametric tests to check the pattern of the parametric results. The resulting pattern of results was almost identical to that of the ANOVA.

For this sample, 19% of the subjects (n = 18) were identified by the MAP as functioning at risk (scores at or below the 5th percentile); 43% of the subjects (n = 41) were identified as possibly at risk (6th to 25th percentile). If we were to omit the psychiatric diagnoses group, which was possibly at risk on only one index score, the percentages would increase to 22% and 50%, respectively.

**Discussion**

The study results indicate that score patterns on the MAP differ between some of the medical/developmental diagnoses; statistically significant differences occurred in 47 out of a possible 126 post hoc comparisons. The MAP total score provided the greatest degree of discrimination between the groups, as has been the case with previous research (Miller, 1987; Miller & Schouten, 1988). Of the individual indexes, the Verbal index differentiated five diagnostic groups from the no-diagnosis group. A discrete speech-language problems group was differentiated from groups with more pervasive problems, including poor verbal performance. The Nonverbal index identified four groups as differing from the no-diagnosis group. Except for the psychiatric diagnoses group's mean Verbal index score, additional between-groups differences did not emerge for either the Verbal or Nonverbal subscales. These subscales were designed to measure cognitive abilities (Miller, 1982) and have been shown to correlate well with IQ scores (Miller, 1987; Miller & Schouten, 1988). Thus, the lack of group differences may indicate a general difficulty with verbal and nonverbal reasoning for all groups in this sample of children with developmental delays.

More variability in scores occurred for the remaining indexes. Neuromaturational skills, measured with the Foundations index, and combined abilities, measured with the Complex Tasks index, were significantly lower for those groups with more extensive and generalized problems, namely the speech-language output problems, developmental delay, and neurological disorders with developmental delay groups. These same groups, plus the psychiatric diagnoses group, demonstrated poor performance on the Coordination index, which measures gross motor, fine motor, and oromotor skills. The poor performance of the first three groups is consistent with their more generalized problems; the poor performance of the psychiatric diagnoses group suggests that the MAP may be useful for early identification of the visuomotor output problems reported for some types of psychiatric and behavioral disorders (Asarnow, 1983; Burnell, 1985; Daniels & Ryley, 1989).

An examination of the mean scores also suggests...
varying degrees of the severity of developmental problems among the various groups on the basis of the MAP scores. The no-diagnosis group attained the highest scores on four of the six MAP scores, followed by the psychiatric diagnoses group with a relatively low score on only one index. The speech-language problems group scored significantly low on one index, which also lowered their total score. The output problems group scored significantly low on two indexes and on the total score. The speech-language output problems group scored significantly low on five of the six MAP scores, whereas the neurological disorders with developmental delay and the developmental delay groups scored significantly low on all of the MAP scores.

The score patterns provide preliminary evidence for the MAP's effectiveness in screening children with functional delays and in screening children with both specific and generalized delays, two concerns raised by DeGangi (1983). The emergence of significant score differences on the ANOVA despite the small numbers in some groups indicates strong between-group differences.

The fact that the majority of MAP scores for this sample fell in the lower percentage ranges rather than being normally distributed is no doubt a reflection of the sample. This was not an asymptomatic group being screened for mild to moderate preacademic problems. Rather, all of the children had suspected or confirmed developmental delays.

In this sample of subjects with suspected or confirmed developmental problems, 62% were identified as at risk or possibly at risk. It may be, however, that some of the children placed in this study's no-diagnosis group actually have subtle preacademic problems that may not be verified until they begin school. Of the 13 subjects in the no-diagnosis group, 4 scored in the yellow category (possibly at risk) on one index score, 1 scored in the yellow category on two index scores, and 1 scored in the red category (at risk) on one index score. The low scores were distributed over the five indexes but were not low enough to lower the total score into the yellow or red categories.

Other factors must also be considered. The subjects were Canadian, but the normative data are for a U.S. population. Differences between U.S. and Canadian diagnostic and referral practices may also exist. In addition, the relationship between a medical/developmental diagnosis and developmental problems is correlational, not causative. Signs, symptoms, and level of function and dysfunction span a range for any developmental diagnosis. Therefore, some children in each category would be expected to function within the average range as well as in the below-average range.

Conclusion

This pilot project provides support for the validity and clinical usefulness of the MAP with pre-school age children with developmental delays or dysfunction. It provides preliminary evidence for the existence of MAP score patterns for some categories of medical/developmental diagnoses as well as support for the MAP's ability to detect various clinical problems. Clinical use of this screening instrument with children whose problems are more marked than the mild to moderate degree described in the test manual seems warranted.

Replication of this study with another, preferably larger, sample is indicated to further substantiate the findings. Item and regression analyses would help refine the discriminative and predictive functions of the individual items as well as the index and total scores. Verification of score pattern consistency between the diagnostic groups could provide support for the use of the MAP to plan intervention strategies.

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References


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