Subtypes of Students With Learning Disabilities Based Upon Gross Motor Functions

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The purpose of this study was to identify possible subtypes of students with learning disabilities based upon gross motor functions. Subjects in a private school for learning difficulties were divided into a group of students with learning disabilities and a comparison group. Gross motor subtests from the Bruininks–Oseretsky Test of Motor Proficiency (Bruininks, 1978) were administered to both learning-disabled and comparison groups. The four subtypes yielded by the K-means iterative partitioning method demonstrated distinct profiles. Cluster membership was shown to be fairly stable by internal validation techniques. The external validity of the four subtypes was verified by a teacher’s ratings of students’ physical behaviors. It was recommended that the outcome of type-specific remediation and the longitudinal stability of gross motor subtypes be evaluated.

Children with learning difficulties have increasingly become the concern of professionals. Despite having normal intelligence, these children are unable to read, write, or calculate at expected levels. Thus they create identification and management problems in both clinical and educational settings.

Without obvious pathological conditions, some of these children exhibit significant movement difficulties that continue to cause problems throughout the school years. Although fine motor problems may have profound effects on a child’s projects in school, they are not so noticeable as the signs of gross motor incoordination. During physical activities, children with poor locomotor and ball skills, for example, may perform crudely. This incoordination can cause difficulty in gaining respect and social acceptance from peers.

Both learning disabilities (LD) and motor incoordination are associated with social and emotional problems. Children with LD feel themselves less accepted socially than children without LD (Renick & Harter, 1988). Moreover, among children with LD, those who display gross motor problems have lower

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self-esteem than those who evidence intact coordination (Shaw, Levine, & Belfer, 1982). Further, it has been found that adolescents who have been suffering from motor problems for a decade still suffer a variety of academic and socioemotional behavior problems (Losse et al., 1991). Thus, motor problems influence the children with LD pervasively and for long periods of their lives.

There has been a continuing debate over the incidence of clumsiness among children more generally classified as LD. Some researchers believe that most children with LD are clumsy (Myklebust, Boshes, Olson, & Cole, 1969). Others disagree with this observation and believe that motor problems are not more prevalent among children with LD than among the nondisabled population (Critchley, 1985; Critchley & Critchley, 1978).

These apparently conflicting points of view may be due to the methodological problems that beset this area of research. For example, clinicians' observations have often been limited to their own clients and therefore do not reflect the wide range of LD population. Surveys conducted at schools often compare the mean scores of motor functions between LD and nondisabled children (e.g., Bruininks, 1978; Conrad, Cermak, & Drake, 1983; Murray, Cermak, & O’Brien, 1990; Sugden & Wann, 1987). This method may obscure individual differences within LD populations. The findings often state that the typical child with LD is relatively clumsier than the average child. The fact is that children, whether with or without LD, may vary in their individual and group motor abilities.

Similar methodological problems exist in the studies of children with motor incoordination. These children are typically compared to controls with respect to selected motor skills. Some researchers consider that a specific motor dysfunction, such as dyspraxia (Denckla, 1984) or kinesthetic disability (Laszlo & Bairstow, 1985), mainly contributes to children's motor problems. Others disagree with this idea that a single factor causes motor impairment. Henderson and Hall (1982) found that the characteristics of motor incoordination varied widely. Similarly, Hulme and Lord (1986) emphasized the heterogeneity of children with motor incoordination and pointed out the lack of studies differentiating subgroups among those children.

Despite the adverse effects of gross motor incoordination, little is known about the characteristics of gross motor functioning among children with LD. Usually, subtypes of these children have been classified on the basis of cognitive skills (Doehring & Hoshko, 1977; Doehring, Hoshko, & Bryans, 1979; Gilger, Eliason, & Richman, 1989; Newman, Wright, & Fields, 1989; Speece, 1987; Swanson, 1988; Swanson, Cochran, & Ewers, 1990) and socioemotional behavior patterns (Fuerst, Fisk, & Rourke, 1989; Speece, McKinney, & Appelbaum, 1985). In the motor domain, only fine motor skills have been included as a part of cognitive assessment for the identification of LD subtypes (Korhonen, 1991; Petruskas & Rourke, 1979; Watson, Goldgar, & Ryschon, 1983). Recently, subgroups of children with motor incoordination have been classified based on both fine and gross motor functions (Hoare, 1994; Lyytinen & Ahonen, 1988; Taylor, 1990). However, the relationship between LD and motor incoordination has not been clarified because these two problems have been treated separately. The missing link may be filled by using the gross motor assessment to identify LD subgroups.

The purpose of this study was to identify homogeneous subtypes of students with LD based upon gross motor functions by cluster analysis techniques. The
secondary purpose of the study was to examine reliability and validity of the clusters using IQ and a teacher’s observations of students’ physical behaviors as validation measures.

**Method**

**Subjects**

The students participating in this study were selected from a pool of 147 students (116 males and 31 females) with a mean age of 11.9 years ($SD = 1.8$), ranging from 8 to 14 years, who attended a private school for learning difficulties. For admission to the school, criteria based upon discrepancies between normal intelligence and low academic achievement (approximately 2 years below the expected standard) were applied. As a secondary criterion, the students also had to be free from severe visual, hearing, and physical disabilities.

For the present study, however, the more stringent criteria set by the State of California were applied to ensure a more homogeneous sample of children with specific learning disabilities (Keogh & MacMillan, 1983). These were a score of 70 or above IQ on the full scale Wechsler Intelligence Scale for Children–Revised (WISC–R) and $-1.5 SD$ or below in at least one of the following standardized academic achievement tests: Slosson Oral Reading Test, and Stanford Achievement Test Series (reading comprehension, vocabulary, mathematics). Fifty-five students (43 males and 12 females) with a mean age of 11.5 years ($SD = 1.9$), ranging from 8 to 14 years, met these criteria.

The 92 students (73 males and 19 females) who were enrolled in the school but did not meet the criteria for learning disabilities served as the comparison group for the reliability of the cluster solution. They had a mean age of 12.2 years ($SD = 1.7$) with a range of 8 to 14 years.

**Measurements**

*Gross Motor Tests.* The five gross motor subtests from the Bruininks–Oseretsky Test of Motor Proficiency (BOTMP) (Bruininks, 1978) were employed as measures of gross motor ability. These were (a) Running Speed and Agility, (b) Balance, (c) Bilateral Coordination, (d) Strength, and (e) Upper Limb Coordination.

*Teacher’s Evaluation.* The students’ regular physical education teacher was asked to evaluate whether the following five descriptors were characteristic of each student as compared to the majority of the same age group, using a 5-point Likert scale. The descriptors included (a) agile, (b) good balance, (c) coordinated, (d) hypotonic, and (e) good ball skills. These five descriptors corresponded with the five gross motor categories of BOTMP.

The reliability of this scale was checked by Cronbach’s alpha (.90) and the Guttman split-half coefficient (.88). To confirm the validity of the teacher’s scale, 55 students with LD were divided into two groups according to the mean $z$ score of the five gross motor subtests from the BOTMP: 7 students with motor incoordination ($SD < -1.5$) and 48 students without motor incoordination ($SD \geq -1.5$). A multivariate analysis of variance (MANOVA) was conducted between the clumsy group and the nonclumsy group with the five items from the teacher’s evaluation serving as dependent variables. There was a significant difference between the two groups, Wilks’s lambda = .586, $F(5, 47) = 6.644$, $p < .01$. The
univariate $F$ tests showed significant differences between the two groups on the “good balance” item, $F(1, 51) = 40.545, p < .01$; the “coordinated” item, $F(1, 51) = 7.004, p < .01$; the “hypotonic” item, $F(1, 51) = 15.895, p < .01$; and the “good ball skills” item, $F(1, 51) = 7.495, p < .01$. However, the correlations between each item and its corresponding subtest were not significant ($p > .05$). Thus, the teacher’s evaluation ratings demonstrated adequate reliability and validity as an indicator of general gross motor functions.

Procedure
The selected gross motor subtests from the BOTMP were administered individually by three testers during physical education class periods. The testers were trained by an adapted physical education specialist certified by the State of California. Students’ physical behaviors were evaluated with regard to the five gross motor categories of the BOTMP by the students’ regular physical education teacher.

Data Treatment
The test results were analyzed statistically by cluster analysis. The procedure of analysis followed the steps taken by Speece et al. (1985). With selection of the cluster analysis method, the choices of similarity coefficient and linkage had to be made (Aldenderfer & Blashfield, 1984). To delineate students with LD for remediation purposes, the absolute level of motor performance was more important than the profile shape. Therefore, Euclidean distance, rather than correlation coefficient, was chosen for the similarity coefficient. The K-means method was the algorithm primarily used for linking the subjects. In addition, the average linkage method and Ward’s minimum variance method were used to examine the stability of subtypes.

This involved three distinct steps. First, all variables were transformed into $z$ scores based on the means and standard deviations of the national norms. Then, a hierarchical agglomerative method was used to classify subjects on the basis of the subtest $z$ scores. This method began with every subject as a cluster and successively merged other subjects or clusters until all subjects were contained in a single cluster. Average linkage method and Ward’s minimum variance method were the algorithms chosen for the agglomerative hierarchical method.

Second, the K-means iterative partitioning method was used to reassign subjects. An initial partition started with two clusters. Subsequently, further cluster solutions were attempted until the reasonable number of clusters was reached. In addition, the cluster profiles were examined graphically for interpretability.

Third, four methods were used to evaluate the adequacy of the cluster solution, including the alternatives algorithm check, split-sample replication, and separate sample forecasting. In these methods, replicability of the derived cluster solution was examined by using different algorithms, splitting the subjects, and using a separate sample. For the alternatives algorithm check, clusters from Ward’s minimum variance method and average linkage method were compared with the clusters from K-means method. In split-sample replication, the subjects with LD were randomly divided into two groups to examine if each subject
would be allocated in the original cluster. In separate sample forecasting, the subtypes derived from the subjects with LD were compared with the subtypes from the comparison group.

Finally, external validity was examined by MANOVA. Regarding the external validity of cluster solutions, McKinney, Short, and Feagans (1985) stated that stable clusters should differ on the variables independent of the measures primarily used for the cluster analysis. In the present study, verbal IQ, performance IQ, full IQ, and the teacher’s ratings served as the measures independent of the gross motor scores from BOTMP. The analyses for reliability and validity were examined by MANOVA and the chi-square test. The computer statistical package programs for all analyses were available from SYSTAT (Wilkinson, 1989).

Results

Preliminary Analysis

Table 1 presents the means and standard deviations of z scores for each subtest from the BOTMP. A one-way ANOVA on the five subtests across the two groups revealed that the LD group and the comparison group differed significantly ($F = 3.55$, $df = 5, 139$, $p < .01$). A post hoc test on pairs of means, using Tukey’s HSD procedure, indicated that the LD group was inferior to the comparison group with respect to running speed, bilateral coordination, and strength.

Cluster Solution

On the basis of the hierarchical cluster analyses, the K-means iterative partitioning technique was then used to produce two, four, and six clusters. To facilitate the optimal interpretation of the three possible solutions, the cluster profiles were plotted according to the BOTMP mean on each subtest. From the profile pattern and the number of students in each cluster, four clusters were judged as the optimum solution for producing subgroups in gross motor performance. The

Table 1  Z Scores of Gross Motor Subtests From the Bruininks–Oseretsky Test of Motor Proficiency Between LD and Comparison Groups

<table>
<thead>
<tr>
<th></th>
<th>LD group</th>
<th></th>
<th>Comparison group</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Running*</td>
<td>-0.729</td>
<td>0.894</td>
<td>-0.200</td>
<td>1.174</td>
</tr>
<tr>
<td>Balance</td>
<td>0.401</td>
<td>1.994</td>
<td>0.448</td>
<td>2.060</td>
</tr>
<tr>
<td>Bilateral coordination*</td>
<td>-0.681</td>
<td>1.157</td>
<td>-0.069</td>
<td>1.182</td>
</tr>
<tr>
<td>Strength*</td>
<td>-0.333</td>
<td>1.301</td>
<td>0.265</td>
<td>1.156</td>
</tr>
<tr>
<td>Upper limb coordination</td>
<td>-0.443</td>
<td>1.660</td>
<td>-0.437</td>
<td>1.603</td>
</tr>
</tbody>
</table>

*p < .01.
profile of the four-cluster solution is depicted in Figure 1. Further, the four-cluster solution is plotted in two-dimensional configuration (Figure 2).

Clusters

**Subtype 1: Free From Motor Problems.** The first cluster consisted of 43.6% (n = 24) of the LD sample. This group showed strength primarily in balance (1.55) and ball skills (0.92). Running speed was slightly below average (−0.28), as was bilateral coordination (−0.38). Overall, this group was free from severe motor problems.

**Subtype 2: Poorly Coordinated.** Approximately one fourth (25.5%, n = 14) of the sample exhibited consistently poor performance in all gross motor subtests. Their performance was low in running speed (−1.24), balance (−1.91), bilateral coordination (−1.61), and ball skills (−1.84). However, they were able to perform the coordination-free strength test with some ease (−0.70).

**Subtype 3: Good Balance.** This cluster contained 23.6% (n = 13) of the sample. The most prominent characteristic of this group was good balance (1.79). The rest of the subtests were below average. Running speed (−1.21), strength (−1.28), and ball skills (−1.83) were well below average, and bilateral coordination (−0.33) was slightly below average.

**Subtype 4: Poor Balance.** A group of 4 students (7.3% of the sample) demonstrated extremely poor balance (−2.93); however, they scored high in strength (1.26) and ball skills (0.82). Running speed (−0.05) and bilateral coordination (−0.37) were close to average.

**Internal Validation**

The four clusters were significantly differentiated by a MANOVA on the gross motor variables used for subtyping, $F(15, 130) = 22.05, p < .01$, with all five univariate tests significant ($p < .01$). Further internal validation was examined by the alternatives algorithm check, split-sample replication, and separate sample forecasting methods.

**Alternatives Algorithm Check.** The four-cluster solution yielded by the K-means iterative partitioning method was compared with the four-cluster solution by the average linkage algorithm, and Ward's minimum variance method. When the Ward's method was applied, 46 out of 55 (83.6%) subjects with LD remained in their original clusters. Of the 9 subjects who moved clusters, 4 from Subtype 2 and 5 from Subtype 1 were all reclassified as Subtype 4. When the average linkage algorithm was applied, 52 out of 55 (94.5%) subjects with LD maintained the original cluster yielded by the K-means method. Among the 3 dislocated subjects, 1 from Subtype 2 was allocated to Subtype 1, and 2 from Subtype 2 were classified as Subtype 4.

**Split-Sample Replication.** The split-sample validation technique was also used to examine whether the divided subjects remained in the original clusters. The 55 subjects with LD were randomly assigned to two groups, consisting of 28 and 27 members. The K-mean iterative partitioning method allocated four clusters in each group. Forty-four (89.1%) out of 55 subjects in the replication clusters maintained their original cluster membership for the four-cluster solution. Nine students (10.9%) were placed in different clusters.
Figure 1 — Mean profile of learning-disabled students based upon the gross motor subtests of the Bruininks-Oseretsky Test of Motor Proficiency. BLC = bilateral coordination; ULC = upper limb coordination.
Figure 2 — Two-dimensional configuration for four clusters of learning-disabled students based upon gross motor functions yielded by the K-means partitioning method. The numbers represent individual subjects and their subtypes. W indicates two subjects at the same location.

Separate Sample Forecasting. A separate sample forecasting procedure was used to classify the comparison group into four clusters. It was assumed that if the clusters were stable, a similar four-cluster pattern should emerge from the comparison group. As shown in Figure 3, the four clusters from the comparison group were similar to the four clusters from the LD group. A MANOVA between the LD and the comparison group clusters indicated that the two sets of four-cluster solutions were not significantly different, Wilks’s lambda = .865, $F(15, 370) = 1.331, p > .05$. However, there was a significant difference in the distribution of the four subtypes between the LD group and the comparison group ($\chi^2 = 11.15, df = 3, p < .05$) (cf. Table 2).

External Validation

IQ Differences Between Clusters. The first external validation was examined by comparing IQ scores (verbal IQ, performance IQ, full IQ) among four clusters. There were differences in IQ scores between the four clusters (cf. Table 3). However, one-way ANOVA did not reveal significant mean differences.

Comparison Between Teacher’s Evaluation and BOTMP. The teacher’s evaluation of students’ physical competence provided the dependent measures for a MANOVA between clusters to determine whether the teacher’s evaluations distinguished the four clusters yielded by the BOTMP. There was no significance
Figure 3 — Comparison of four gross motor subtypes between the learning-disabled group and the control group based upon the gross motor subtests of the Bruininks–Oseretsky Test of Motor Proficiency. BLC = bilateral coordination; ULC = upper limb coordination.

in the result of multivariate analysis. However, univariate analyses of the five separate items in the teacher’s evaluation indicated a significant difference between the four clusters \(F = 3.37, df = 3, 49, p < .05\) on the item labeled “coordinated.”

**Discussion**

The primary purpose of this study was to determine whether students with LD could be reliably subdivided on the basis of their gross motor performance alone
### Table 2  Membership of Subgroups in LD and Comparison Groups

<table>
<thead>
<tr>
<th>Subtype</th>
<th>LD group Membership</th>
<th>% Within group</th>
<th>Comparison group Membership</th>
<th>% Within group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24</td>
<td>43.6</td>
<td>30</td>
<td>32.6</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>25.5</td>
<td>24</td>
<td>26.1</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>23.6</td>
<td>26</td>
<td>28.3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>7.3</td>
<td>12</td>
<td>13.0</td>
</tr>
</tbody>
</table>

### Table 3  IQ Scores as a Function of Gross Motor Subtype

<table>
<thead>
<tr>
<th>Subtype</th>
<th>n</th>
<th>Verbal IQ M</th>
<th>SD</th>
<th>Performance IQ M</th>
<th>SD</th>
<th>Full IQ M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24</td>
<td>106.6</td>
<td>17.3</td>
<td>102.0</td>
<td>14.7</td>
<td>105.1</td>
<td>16.5</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>102.4</td>
<td>13.9</td>
<td>95.4</td>
<td>14.8</td>
<td>98.7</td>
<td>12.3</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>101.2</td>
<td>9.3</td>
<td>97.5</td>
<td>14.2</td>
<td>99.1</td>
<td>11.3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>94.8</td>
<td>8.0</td>
<td>88.5</td>
<td>12.6</td>
<td>90.3</td>
<td>2.1</td>
</tr>
</tbody>
</table>

using the items from the BOTMP as representative of gross motor action. The secondary purpose was to determine the reliability and validity of the yielded subtypes. When a series of convergent techniques were used, the results suggested that four distinct profiles could be distinguished. The external validity of the four subtypes was verified by the "coordinated" item in the teacher's evaluation of the students' physical competence.

In the present study, the replicability of the four-cluster solution varied from 83.6% to 94.5% according to different internal validity methods. Although these percentages are fairly high when they are compared to the 70% and 77% replicability quoted by Hoare (1994), the fact that several students may be misplaced depending on the sampling methods and different algorithms used for the analysis suggests that the results of cluster analysis should be treated with caution when the approach is being applied to educational placement.

As for IQ, the gross motor subgroups were not significantly different on the basis of IQ scores. The standard deviation for the Subtype 4 full IQ mean was relatively small due to the small number of membership and also due to the discrepancy between verbal IQ and performance IQ typically seen in the LD population. McKinney et al. (1985) insisted that cluster solutions with reasonable internal stability should differ on variables that are independent of the original variables used to yield the original clusters. Results suggested that IQ was too different from gross motor function to serve as an external validity measure. This finding implied that variables chosen for external validity should not be
completely independent of the original variable. Therefore, the measurement of fine motor skills might have served as an appropriate variable for external validity.

When the teacher’s views of the four groups of students were compared, only the “coordinated” item distinguished among them. None of the other four items nor all five items as a whole could separate the groups. While this finding suggests that the teacher’s observation of coordination could validate the four-cluster solution, it also implies that the objective measurement of gross motor subfunctions is necessary to supplement the teacher’s observation.

It is important to note that 43.6% of the students with LD and 32.6% of the students from the comparison group were not hindered by gross motor problems. Whereas previous studies (e.g., Bruininks, 1978; Conrad et al., 1983; Murray et al., 1990; Sugden & Wann, 1987) have tended to focus on the fact that, as a group, children with LD tend to perform less well than their peers, it would be misleading to infer from their results that all children with LD are clumsy. In fact, the present study demonstrated that as many as 43.6% of the subjects were free from gross motor problems.

The present research has shown that four gross motor subtypes are evident in both a highly selected group of children with LD and a more loosely defined group of children with LD. The differences between the subtypes suggest potential usefulness of type-specific remediation.

For example, it seems fairly clear that the students in Subtype 1 do not require any remedial programs since they are free from severe gross motor dysfunction. Nevertheless, physical activities may provide an ideal vehicle for these students to gain self-confidence and social acceptance.

In contrast, students who are poor in all gross motor functions need specifically designed remedial programs. A special program for Subtype 2 students should, of course, consider the progress in relation to the students’ socioemotional well-being. Children with both LD and physical awkwardness tend to have lower self-esteem than do children with LD without awkwardness (Shaw et al., 1982). Gubbay (1975) considered that the priority in managing children who are clumsy is to lift their emotional burdens. Reid (1987) suggested that to develop clumsy children’s perceptions of competence, the provision of success experiences, positive verbal feedback about performance, and attributional retraining are all useful. A careful task analysis is also required to allow children with motor incoordination to experience success and receive positive feedback. Research has shown that combinations of success experiences and positive feedback have facilitated both intrinsic motivation and perceived competence and have improved movement skills (Vallerand & Reid, 1984).

Subtype 3 is characterized by good balancing ability regardless of poor performance in the other gross motor domains. It is possible that good balance may not compensate in any way for overall physical difficulty. In such a case, Subtype 3 students may have to be treated in the manner similar to Subtype 2 students. To avoid negative emotional reactions to remediation, students should be encouraged to focus on the strongest area (i.e., good balancing ability) with indirect attention to weak areas (Coplin & Morgan, 1988).

The students in Subtype 4 exhibited extremely poor balancing abilities in contrast to near-average or greater-than-average gross motor function on the other subtests. Obviously, Subtype 4 students need special training in balance, and effective methods are currently available (Horvat, 1982; Khalsa, Don Morris,
Sifft, 1988). After a review of literature on balance studies, Williams (1983) concluded that balancing ability per se has no significant effects on athletic performance. Therefore, Subtype 4 students, who suffer primarily from poor balancing ability, will probably perform well in various physical activities. However, special attention to safety must be paid when they practice high-risk tasks requiring good balancing skills.

This study should be repeated with children free from LD to examine cross validation of the four gross motor subtypes. If similar gross motor subtypes emerge from the population without LD, then the distribution of the four subtypes should be contrasted between the populations with LD and without. If the ratio of a certain subtype within the population with LD is significantly larger than that of the population without LD, then that characteristic of the specific subtype may provide a clue about the relationships between learning disabilities and motor dysfunction. In addition, Reid (1987) encouraged researchers to compare the motor profiles between children with both LD and motor incoordination, and children with motor incoordination without LD. Findings from this type of comparison may also contribute to our understanding.

A study should be designed to examine the longitudinal stability of the yielded gross motor subtypes. Research has shown that longitudinal stability was maintained with neuropsychological LD subtypes (Korhonen, 1991) but not with behavioral LD subtypes (McKinney, 1989; McKinney & Speece, 1986). In the motor domain, Lyytinen and Ahonen (1988) indicated that five motor subgroups of LD children demonstrated different developmental courses. The lack of longitudinal stability in the study of Lyytinen and Ahonen (1988) might be derived from the inclusion of numerous motor tests. The selection of measures directly influences the subtypes identified and their longitudinal stability of subtypes. Lyytinen and Ahonen (1989) suggested that every motor factor has its unique developmental course. Further study should explore the developmental trend of subtypes based on each motor factor, such as the gross motor functions examined in this study.

The usefulness of subtype studies lies in the formulation of type-specific interventions, otherwise termed *aptitude-treatment interaction* by Cronbach (1975). To design remedial programs, it is important to determine the relationships between abilities and how an assigned task improves them. Once those relationships have been clearly identified, researchers must then choose which tasks will be used in remedial programs.

Cratty (1980) proposed both a broad transfer width model and a narrow transfer width model. The broad transfer width model promises a wide range of effects from limited training tasks, whereas the narrow transfer width model focuses on symptom-specific training. Rimmer and Kelly (1989) directly examined the effect of two motor remediation programs, one based on the broad transfer width model and another based on the narrow transfer width model, both designed for gross motor development of LD preschoolers; the children in the narrow transfer width program improved more than the children in the broad transfer width program. Similarly, Revie and Larkin (1993) reported that task-specific intervention for poorly coordinated children could improve only specifically trained skills. These results supported the validity of the narrow transfer width model and suggested the usefulness of type-specific remediation in the gross motor domain.
In contrast, Keogh (1988) stated that there is no evidence to support the effectiveness of different intervention programs in the academic domain. Keogh (1988) further pointed out the lack of programmatic research across different subgroups.

Researchers should develop and conduct type-specific interventions and should then assess their effectiveness in comparison with that of conventional unspecified approaches. Keogh and MacMillan (1983) indicated that the motivation for research comes not from the need to test theory but primarily from the need to solve practical problems. Researchers need to use research results to solve practical problems as well as theoretical issues (Kavale & Forness, 1987). Research data applied to practice is the best way to make research elaboration valuable in the real world.

References


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