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ABSTRACT

This paper addresses the problem of heterogeneity of samples of learning disabled (LD) children by comparing five different systems for identifying homogeneous subgroups in terms of their ability to predict longitudinal reading and mathematics scores. One hundred and sixty LD children served as subjects. Three of the five subgrouping systems were based upon the Wechsler Intelligence Scale for Children--Revised (WISC-R), but did not predict achievement. One system based upon clinical diagnostic criteria and one based upon the magnitude of the child's achievement deficit did predict achievement. The former system predicted both reading and mathematics achievement, while the latter system predicted only reading achievement. A pairwise regression analysis demonstrated that most of the predictive variance of the system based upon the magnitude of achievement deficit was accounted for by the clinical diagnostic system. A further analysis of the diagnostic system indicated that a subgroup of LD children who showed evidence of mild socioemotional disturbance performed significantly better at each time of measurement over a 4-year period, and performed at an accelerated rate compared to a subgroup of LD children without signs of a socioemotional disturbance. These results are interpreted as support for a system of subgrouping LD children based upon effective variables. The implications of this system for research and treatment of learning disabilities are considered. A five-page reference list follows the study. (Author/JAZ)

A Longitudinal Comparison of Systems Used to Identify Subgroups of Learning Disabled Children

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Abstract

This paper addresses the problem of heterogeneity of samples of learning disabled (LD) children by comparing five different systems for identifying homogeneous subgroups in terms of their ability to predict longitudinal reading and math scores. One-hundred and sixty LD children, attending a school for the learning disabled, served as subjects. Three of the five subrouping systems were based upon the WISC-R, but did not predict achievement. One system based upon clinical diagnostic criteria and one based upon the magnitude of the child's achievement deficit did predict achievement. The former system predicted both reading and math achievement, while the latter system predicted only reading achievement. A pairwise regression analysis demonstrated that most of the predictive variance of the system based upon the magnitude of achievement deficit was accounted for by the clinical diagnostic system. A further analysis of the diagnostic system indicated that a subgroup of LD children who showed evidence of mild socioemotional disturbance performed significantly better at each time of measurement over a four year period, and performed at an accelerated rate compared to a subgroup of LD children without signs of a socioemotional disturbance. These results are interpreted as support for a system of subgrouping LD children based upon affective variables. The implications of this system for research and treatment of learning disabilities are considered.

A Longitudinal Comparison of Systems Used to Identify Subgroups of Learning Disabled Children

One obstacle to a clearer understanding of learning disabilities (LD) is the exclusionary nature of its definition. Basically, children are diagnosed as having a learning disability if they have a deficiency in one or more areas of academic achievement (such as reading, math, or written expression) and do not have any of a number of other handicapping conditions (such as sensory impairment, emotional disturbance, mental retardation, or environmental deprivation) that could readily account for their classroom difficulty. In essence, LD is defined by what it is not, rather than by what it is.

Because no single academic, behavioral, or physiological deficit has been established as the sole or even primary source of learning disability (Doris, 1986; Smith, 1983), despite years of research and practice, children with a wide variety of deficits will be found in LD classrooms (e.g., Shepard, Smith, & Vojir 1983). Subsequent comparisons of these heterogeneous LD samples with nondisabled controls have revealed a multitude of deficits in samples of LD children that appear to be descriptive of the population of LD children but in fact are descriptive of only one or another subgroup of LD children (e.g., Goldstein & Golding, in press).

As a result the field has a multitude of single factor theories but little or no consensus as to the cause or the appropriate treatment of LD.

In recent years investigators in the fi⌐ld have come to accept the existence of distinct subgroups of children (Doris, 1986) and a variety of subgrouping systems fo ir reliable identification are being explored (Fisk & Ro 1983; Harris, 1982; Lyon & Watson, 1981; McKinney, 1984, in pre s; Satz & Morris, 1981; Torgesen, 1982).

There are many different bases for subgrouping systems. In a recent review, McKinney (in press) has described three basic approaches: 1. clinical-inferential subtypes, in which children are matched on their performance on psychoeducational or neurological tests in accordance with some a priori hypotheses or clinical impressions (e.g., Pirozzolo, 1979); 2. empirically derived subtypes, in which statistical methods - either Q-factor analysis or cluster analysis - are used to sort children's test scores into homogeneous subgroups without regard to a priori conceptualizations (e.g., Doehring & Hoshko, 1977); and 3. rationally defined subtypes in which one subgroup is chosen on the basis of one key variable, such as a short-term memory deficit (e.g., Torgesen & Houck, 1980).

These attempts at identifying subgroups have been of mixed success and as yet no consensus as to the best approach has emerged (McKinney, in press). In addition, there are limitations of current subgrouping approaches. Most importantly, there is a need for external validity. In particular, it is necessary to determine whether subgroup membership is related to differential academic performance over time. In addition, no comparisons of different subgrouping systems have as yet appeared in the literature. Such an examination might reveal that one system is clearly superior to other systems, or that combinations of subgrouping systems best account for the variability of LD children's behavior. The underlying dimensions of the successful subgrouping system (s) would provide rich hypotheses for future studies of the etiology and treatment of LD.

Toward this end, our study compared the ability of five subgrouping systems to predict academic achievement in reading and math over a period of four years. Achievement measures are useful criteria on which to compare subgrouping systems, because poor academic achievement is the fundamental problem of LD children. These five systems are all of the clinical-inferential variety. Three of the systems are based on the WISC-R (i.e., verbal-performance discrepancy, subtest scatter, and the Bannatyne recategorization of WISC-R subtests). Although a number of investigators have recently questioned the diagnostic utility of the Wechsler scales (Berk, 1982, 1983; Gutkin, 1979; Kavale & Forness, 1984), the apparent inability of the various manipulations of the Wechsler scale subtests to differentiate LD children from other children may be a function of the subgrouping problem. That is, perhaps some subgroups of LD children demonstrate distinct subtest patterns that are meaningfully related to their academic performance, whereas others do not. By collapsing across these subgroups the mean performance of the heterogeneous LD group might not be sufficiently distinct from average achievers. Therefore, following this line of reasoning, subgrouping LD children according to the WISC-R profiles might be useful for understanding both intra- and inter-group differences. The fourth subgrouping system is derived from clinical diagnostic criteria, in which LD children with either a socio-emotional or hyperactive/organic dimension to their disability are compared with LD children without these additional dimensions. The fifth system is based on the magnitude of the child's achievement deficit, in which children with a severe deficit are compared with children who demonstrate a milder deficit. A more complete description of each subgrouping system will be presented in the Methods section.

Of the many subgrouping systems suggested in the literature, these five (all of the clinical-inferential variety) were chosen because: 1. they have shown promise in previous research (e.g., Goldstein & Dundon, in press; Goldstein, Paul, & Sanfilippo-Cohn, 1985; Pirozzolo, 1979); and 2. the measures used to form them are readily available to most teachers and researchers. Because comparisons of these subgrouping systems have never been made, no specific hypotheses were formulated.

Method

Subjects. The children who participated in this study were all enrolled in a full-time, 12 month educational program under the auspices of a comprehensive child guidance institute located in a large metropolitan area. The educational program serves approximately 250 children with learning and behavioral problems, the majority of whom have either already been diagnosed as learning disabled by the public school system or would be diagnosed as such if they were currently in public school. In addition, each child and his or her family receives comprehensive testing and interviewing in order to provide a precise diagnosis of the child's difficulties. This diagnosis is reevaluated at regular intervals by the institute's multi-disciplinary diagnostic team. Many of the children are assigned multiple diagnoses as a result of this process, such as learning disability with socioemotional disturbance. The children in the program come from families that are eligible to receive medical assistance, and consequently they are from poverty level families. In addition, 98% of them are black. See Goldstein, Dundon, and Wasik (1984) for further information on the subject population.

Despite the fact that these children are economically disadvantaged and black, we believe they should not be excluded from the LD category. First, the academic difficulties of these children cannot be attributed solely to their disadvantaged status. Goldstein et al. (1985) have demonstrated that the children in this sample are significantly lower in reading achievement compared to non-disabled black children from the same neighborhoods. Second, there is no conceptual or empirical basis for *a priori* exclusion of black children from the LD category. Leinhardt, Seewald, & Zigmund (1982) demonstrated that black and white LD children do not differ in terms of level of achievement and other diagnostically relevant variables. In fact, they argue that black children on average more closely fit LD criteria, white children being more often asigned to this category with a more correct placement would be educable mentally retarded or emotionally disturbed.

Nevertheless, any large group of children such as the one described here will contain some who should be excluded from an LD sample. Children were excluded from this investigation if they:

(1) had a serious emotional problem as determined by a multidisciplinary diagnostic team; (2) had visual or auditory problems; (3) had a WISC-R Full Scale IQ below 80; and/or (4) were not significantly underachieving. In this study underachievement is defined as at or below 75% of the child's expected level of achievement based upon age and IQ. The expected level was based upon the formula proposed for inclusion in PL 94-142 (USOE, 1976).

Of the 160 subjects meeting the above LD criteria, 126 were boys and 34 were girls. Their mean Full Scale IQ was 97.3 (SD = 10.2); the V IQ mean was 95.0 (SD = 10.6); the mean P IQ was 100.7 (SD = 11.5). These scores are very close to those reported by Kavale & Forness (1984) who presented IQ equivalents from a meta-analysis of 94 LD samples (viz., 97, 94, 98, respectively). The average child in this sample was 88 months (SD = 12.2) old when he or she began school at the institute. The mean score on the Woodcock Reading test at time of entry was 1.4 (SD = .40, n = 95); the mean Key Math score was 1.7 (SD = .76, n = 99). Of the 160 subjects, 81 had both reading and math scores that were 75% of expected levels or below, 71 had only reading scores that were 75% of expected levels or below, and 8 had only arithmetic scores that were 75% of expected levels or below.

Procedure

Test Administration. During the first six weeks after a child enrolled in the school program, a multidisciplinary treatment team completed a diagnostic study. During this period a diagnosis was agreed upon, the age appropriate Wechsler scale was administered by a staff psychologist, and the Woodcock Reading Mastery Tests (Woodcock, 1973) and Key Math Diagnostic Arithmetic

Test (Connolly, Nachtman, & Pritchett, 1976) were administered by the classroom teachers. The age appropriate Wechsler scale was given every 18 months thereafter, and the first administration of the WISC-R was used to determine a child's placement in a WISC-R based subgrouping system. The achievement tests were given during May of each subsequent year. There were up to four years of longitudinal achievement data on each child (five times of measurement), although many children did not have complete data.

Subgroup Assignment

Verbal-performance discrepancy. Typically, three subgroups have been formed using the Verbal IQ (V IQ) - Performance IQ (P IQ) discrepancy system: 1. V IQ greater than P IQ (V > P), 2. P IQ greater than V IQ (P > V), and 3. V IQ not significantly discrepant from P IQ (V = P). A review by Dudley-Marling, Kaufman, and Tarver (1981) has summarized empirical support for this system. For the V-P discrepancy system, Kaufman (1979) recommended a discrepancy of at least 12 points as a reliable difference for individual subjects. Therefore, one group had a verbal score at least 12 points higher than the performance score, another group had a performance score at least 12 points higher than the verbal score, and the third group had verbal and performance scores that differed by less than 12 points.

Subtest scatter. A significant amount of subtest scatter has been interpreted by some diagnosticians as an indication of a possible learning disability (Kaufman, 1979). At least two investigators have suggested that it may be educationally relevant to subdivide samples of LD children according to the amount of subtest scatter (Kaufman, 1981; Tabachnick, 1979). Kaufman (1979) recommended a range of at least 10 points between the highest and lowest subtest scores as a "reasonable cut-off point between 'normal variability' and 'substantial scatter'" (p. 198). Therefore, two groups were formed, those with a range of at least 10 points and those with less than a 10 point subtest scatter.

Bannatyne recategorization of the WISC and WISC-R subtests. Bannatyne (1971) proposed an alternative way of combining the WISC-R subtests. He formed three scales from the subtests, the Spatial, Conceptual, and Sequential scales. The Spatial (Sp) scale, comprised of the object assembly, block design, and picture completion subtests, refers to a child's ability to physically or symbolically manipulate objects. The Conceptual (C) scale, based on vocabulary, comprehension, and similarities subtests, pertains to the child's language related skills. The Sequential (Sq) scale, formed by combining the digit span, coding, and arithmetic subtests, relates to the child's auditory and visual short-term memory storage.

Based upon clinical experience, a review of the literature, and his own research, Bannatyne (1971) reported that one subgroup of dyslexics showed a consistent pattern on the WISC such that their Sp score was higher than their C score which was higher than their Sq score (Sp > C > Sq). This profile has been generalized to groups of reading disabled children (Rugel, 1974; Decker & Corley, 1984) and LD children (Smith, Coleman, Dokecki, and Davis, 1977; Ryckman & Elrod, 1983). The Sp, C, and Sq scales were computed by summing the three scores on the three subtests that comprised each scale. Each scale score was compared against the mean of the three scales. Based on formulae from Davis (1959), and correcting the overall probability level to account for three comparisons, Reynolds (1981) offered the following values necessary for a significant discrepancy ($p < .05$) between each scale and the mean scale score: at least 4.82 for Sp, 4.52 for C, and 4.89 for Sq. Only those subjects whose Sp score was at least 4.82 points higher than their mean, whose C score was not 4.52 points higher or lower than the mean, and whose Sq score was at least 4.89 points lower than the mean were included in the group who met the Bannatyne profile. Thus, two groups were formed, those who did and those who did not demonstrate the Bannatyne pattern.

Clinical Diagnostic Subgrouping Scheme. Although definitions of LD exclude children with "emotional disturbance", Goldstein & Dundon (in press) and Goldstein et al. (1985) have recently reported on the widespread and significant presence of mild and hitherto unrecognized social-emotional difficulties in subgroups of LD children. In these studies, one LD subgroup had a possible organic component to their learning problems; the other two subgroups, not showing evidence of organicity, differed on the presence or absence of signs of mild socioemotional problems. Goldstein et al. (1985) reported that the patterns of correlations among IQ, achievement, and depression were significantly different among these subgroups. Similarly, Bell, Goldstein, Gerstein, & Haimo (1983) found differences between subgroups of LD children with and without mild social-emotional problems on the correlations of IQ and achievement with the scores on the Bender Gestalt and Rutgers Drawing tests.

In the present study, three subgroups, similar to those in the above studies, were formed based on reports from multi-disciplinary diagnostic conferences. The three groups were 1) learning disabled with a possible organic or hyperactive component (LD/OH), 2) learning disabled with mild socioemotional disturbance (LD/SED), and 3) learning disabled with neither an organic or hyperactive component nor a socioemotional disturbance (LD).

Percent of Expected Achievement Subgrouping Scheme. There is currently no agreement among researchers over the severity of the discrepancy between ability and achievement necessary to determine if a child is learning disabled (Smith, 1983). Further, Poplin (1981) argued that the severely disabled LD child is often neglected by researchers. It is very possible that the severely disabled and the mildly disabled represent distinct subgroups. Whereas some investigators have formed subgroups of LD children based on qualitative differences on academic achievement tasks (e.g., Boder's 1973 classification based on reading and spelling errors), to our knowledge an analysis of subgroups based on quantitative achievement differences has yet to be reported. Accordingly, this subgrouping scheme was operationalized by considering the percent discrepancy below expected achievement levels. Two subgroups of LD children were formed, those who were performing at 51% to 75% of expected grade level achievement (the mildly disabled), and those who were performing at 50% or below their expected grade level (the severely disabled). This system will be referred to as the PEA for percent of expected achievement.

Design

The analyses reported below were conducted in three stages. First, the ability of each subgrouping system to predict achievement at each of the five times of measurement was tested by means of regression analyses. Those systems that were significant predictors at the same time of measurement were then compared pairwise using a stepwise regression procedure. The order of entry of the systems into the equation was alternated to examine the relative contribution of each system to the R^2. The system that best predicted achievement was then examined using a repeated measures ANOVA to examine the rates of achievement of the different subgroups for that system. The Huynh-Feldt corrected analysis was calculated, yielding the same results as those of the uncorrected analysis. Therefore, only the uncorrected analysis will be reported.

Results

Regression analyses

Verbal-performance discrepancy system

Of the 160 subjects, 15 (9.4%) had a V IQ (*M* = 105.9) score at least 12 points larger than the P IQ (*M* = 90.9), 48 (30.0%) had the reverse pattern (*M* P IQ = 109.7, *M* V IQ = 89.7), and 97 subjects (60.6%) had V and P IQ scores that were not different by 12 points (*M* V IQ = 95.7, *M* P IQ = 97.6). This system did not predict reading or math achievement at any of the five times of measurement. The largest R^2 was .04.

Subtest scatter system

In this sample 29 subjects (18%) had a range between the lowest and highest subtest score of at least 10 points (*M* = 11.6);

131 subjects (82%) had a range of less than 10 points (M = 6.9). As with the V-P system, the subtest scatter system did not predic reading or math achievement at any of the times of measurement. The largest R^2 was .03.

Bannatyne system

Only 18 of the 160 subjects demonstrated the Bannatyne profile as defined in this paper. This number (11.3% of the total) was within the range identified in other studies, but was considered too small to adequately analyze and compare with other subgrouping systems. Therefore, we selected all the LD subjects who had significantly depressed scores on the Sequential category. Forty-one subjects (25.6%) met this criterion. Two subgroups were formed, those with and those without depressed Sequential category scores. This system, though, did not predict reaoing or math achievement at any of the times of measurement. The largest R^2 was .01.

Thus, none of the subgrouping systems based on the WISC-R predicted reading or math achievement at any of the five times of measurement. As a result these subgrouping schemes will not be considered further.

Percent of expected achievement system

Of the 160 subjects, 104 (65%) had reading or math scores that were 75% or less of expected normal levels but greater than 50%; 56 subjects (35%) had scores that were 50% or below expected levels. This sytem was a significant predictor of achievement. The third column of the upper panel of table 1 (Step 1, PEA R^2) demonstrates that the PEA subgrouping scheme was a statistically significant predictor of reading achievement at the first two times of measurement. It was a marginally significant predictor of reading achievement ($p < .10$) at the last three times. The PEA system did not predict math achievement at any point in time. The largest R^2 was .02.

Insert table 1 about here

Diagnostic system

Twenty-six subjects (16.3%) belonged to the LD/OH group; 57 (35.6%) belonged to the LD/SED group; and 77 (48.1%) belonged to the LD group. The diagnostic subgrouping scheme was a significant predictor of reading achievement at all five times of measurement. These data are presented in the third column of the lower panel of table 1 (Step 1, DS R^2). Additionally, this system was a significant predictor of math achievement for time 4 ($R^2 = .088$, $p < .01$, $n = 110$) and time 5 ($R^2 = .135$, $p < .05$, $n = 61$).

Comparison of subgrouping systems

Although the diagnostic system predicted math achievement at only times 4 and 5, it was clearly superior to any other system examined in this study, as no other system was a significant predictor of math achievement. Therefore, it was not necessary to statistically compare any of the systems on math achievement.

For reading achievement two subgrouping systems were significant predictors, the PEA and diagnostic systems. To determine the most effective subgrouping scheme, the diagnostic system and the PEA system were compared using a stepwise regression analysis, alternating the order of entry of each system into the regression equation. Table 1 presents a summary of the comparison of the two diagnostic systems as predictors of reading achievement. In the top half of the table, the PEA system was entered first into the equation followed by the diagnostic system. F tests of the gain in R^2 demonstrated that the diagnostic subgrouping system added significantly to the prediction of reading achievement at times 2 to 5. The increase in R^2 was marginally significant at time 1 ($p < .10$)

The lower half of table 1 presents the results of the regression analysis when the diagnostic system was entered first and the PEA system was entered second. At time 2 the PEA system added significantly to the R^2; at time 1 the increase was marginally significant ($p < .10$); at times 3 to 5 the increase was not significant.

It was concluded that the most effective subgrouping system was based on the diagnoses given to the children upon entry to the school system. The PEA system added significantly to the diagnostic system in the prediction of reading achievement only at time 2, whereas the diagnostic system added significantly to the PEA system at times 2 to 5. Additionally, the diagnostic system was the only system to significantly predict math achievement. It was this system for subgrouping that was considered in greater detail.

<u>In depth analysis of the Diagnostic subgrouping system</u>

At each time of testing, the number of subjects varied. Therefore, subjects were selected from the original sample of 160 who had complete reading and math achievement at times 2, 3, and 4 (i.e., after 1, 2, and 3 years in the school). Ninety subjects met these criteria; 73 were boys and 17 were girls. Table 2 presents the full scale IQ and starting age for the three groups. ANOVA's comparing these groups showed that they did not differ on IQ ($F(2,87) = 1.99$, $p > .05$) or starting age ($F(2,87) = 1.16$, $p > .05$).

Insert table 2 about here

Table 3 presents the means and standard deviations for the Woodcock Reading and Key Math scores for each of the diagnostic subgroups for the three consecutive times of measurement. The reading and math scores were analyzed separately using 3 (groups) X 3 (times of measurement) repeated measures ANOVAs.

Insert table 3 about here

For the Key Math scores there were significant main effects for groups ($F(2,87) = 3.78$, $p < .05$) and times of measurement ($F(2,174) = 147.86$, $p < .001$). The groups by time interaction was not significant. The Scheffé post hoc test for times of measurement revealed that the groups improved significantly each year. The Scheffé post hoc test for groups did not reveal any significant differences among groups. However, the significant main effect of the ANOVA suggested that the groups at either extreme were significantly different. At the least, it was concluded that there were differences among the three groups on math achievement.

For the Woodcock Reading scores there was a significant main effect for groups ($F(2,87) = 9.89$, $p < .001$), a significant main effect for times of measurement ($F(2,174) = 158.86$, $p < .001$), a significant groups by times interaction ($F(4,174) = 3.00$, $p < .05$). It was of primary interest to determine if the groups performed at different rates over time. Therefore, three F tes for simple effects were performed comparing each pair of groups (Bruning & Kintz, 1977). The comparison of the LD with the LD/ groups was significant ($F(2,174) = 5.54$, $p < .005$). The other two comparisons were not significant.

A visual inspection of the means in table 3 suggests that locus of the significant interaction occurred between times thr and four. The LD group made a gain of 0.5, while the LD/SED gr gained one full grade during the same time period. A 2(groups) 2(times of measurement) post hoc ANOVA substantiated this impression. The interaction term was significant ($F(1,74) = 6.$ $p < .01$).

Therefore, the LD group differed from the LD/SED group in pattern of reading achievement. The groups seemed to diverge after two years ofschooling. The LD and LD/SED groups did not differ from the LD/OH group in their patterns of improvememt.

Discussion

WISC-R subgrouping systems

None of the subgrouping systems based on the WISC-R was a significant predictor of reading or math achievement. Kavale a Forness (1984) conducted a recent meta-analysis of 94 studies t utilized the WPPSI, WISC, or WISC-R for the differential diagno of learning disabilities. They concluded that there was insufficient evidence to warrant the use of the Wechsler scales differential diagnostic tools. Similarly, no support was found the present study for using the WISC-R as a tool for forming subgroups of LD children. However, the utility of the Full Scale score as a broad indicator of intellectual ability is not compromised by these findings, a point also made by Kavale and Forness.

<u>PEA and Diagnostic subgrouping systems</u>

Using the PEA system, two groups of LD children were identified based on the degree of discrepancy between actual and expected levels of achievement. Because the variables used for subgroup assignment were the same as those used for subgroup validation, differences between the mildly and severely disabled subgroups were anticipated. Not surprisingly, the two groups differed on reading achievement at the first two times of measurement. These differences were maintained at the later times of measurement, but only at marginal levels of significance. As one would expect that earlier levels of achievement should be good predictors of later achievement, the weak relationship was noteworthy.

The diagnostic system did, in fact, account for the reading achievement variance from the PEA system during the last three times of measurement. The diagnostic system was also the only significant predictor of math achievement. It was concluded that this last system was the best of those examined in this study and deserved closer scrutiny.

At least two distinct subgroups were identified based on broad groupings of diagnostic categories. These two groups differed with respect to mild emotional problems co-occuring with their learning problems. The LD/SED group, who had mild emotional problems, was not only better at each time of measurement, but also demonstrated a better rate of reading achievement than the LD group, who did not have mild emotional problems. The LD/SED group demonstrated accelerating gains during their school years, gaining a full year in reading achievement during their third year in school. The LD group, on the other hand, progressed at a more modest, steady rate gaining only about 6 tenths of a grade each year.

This study offers further support to earlier work by Goldstein & Dundon (in press) and Goldstein, et al. (1985) who propose that consideration of a socioemotional component can add to the understanding of learning disabilities. Goldstein & Dundon (in press) argue that in some cases mild emotional problems can actually be the primary cause of learning disabilities for a subgroup of children, and they offer a theoretical framework that encompasses socioemotional problems as both a consequence and a cause of learning disabilities. In the present investigation, a subgrouping scheme that includes socioemotional factors was shown to be superior to other proposed subgrouping systems. In addition, both Satz & Morris (1981) and Lyon & Watson (1981) reported the existence of subgroups of LD children who appear to be similar to the present LD/SED subgroup. Future work that considers the role of socioemotional factors in the identification and treatment of learning disabilities seems warranted.

This study also supports the validity of the multi-disciplinary diagnostic procedure that was used. Very few studies have examined the reliability or validity of the childhood diagnostic categories or the classification process (Davison &

Neale, 1982). The most successful subgrouping scheme reported in this paper was based on DSM-II or ICD#9 criteria agreed upon in a multi-disciplinary setting. Although the purpose of this paper was not to 'tease apart' which aspects of the diagostic procedure were effective, it can be concluded that the utility of this process was supported. We suggest the groupings of standard diagnostic criteria outlined in table 4 as a preliminary guide in this effort.

Insert table 4 about here

For the practitioner the results of this study seem especially relevant. An educator faced with a heterogeneous LD sample should look for evidence of socioemotional problems as a first step in subdividing the sample. In developing individual treatment plans, the practitioner might weigh therapeutic exercises more heavily for the LD/SED group and cognitive/information processing exercises more heavily for the LD group. While we recognize that these suggestions are only speculations at this time, they deserve careful attention because of the relative success of considering socioemotional variables while trying to impose order on the heterogeneous mix of symptoms and etiologies known as learning disabilities.

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Table 1

Comparison of PEA and Diagnostic Subgrouping (DS) Schemes as Predictors of Reading Achievement

Time of Testing	n	Step 1 PEA R^2	Step 2 DS R^2	Gain in R^2	F test df	F test for gain
1	95	.05*	.10*	.05	2,91	2.51
2	138	.04*	.11**	.06	2,134	5.08**
3	148	.02	.11***	.09	2,144	6.95**
4	110	.03	.20***	.17	2,106	11.68***
5	61	.05	.25***	.20	2,57	7.52**

Time of Testing	n	Step 1 DS R^2	Step 2 PEA R^2	Gain in R^2	F test df	F test for gain
1	95	.07*	.10*	.03	1,91	3.54
2	138	.08**	.11**	.03	1,134	4.37*
3	148	.10***	.11***	.01	1,144	2.36
4	110	.19***	.20***	.01	1,106	1.29
5	61	.23***	.25***	.02	1,57	1.55

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 2

Means and Standard Deviations for Full Scale IQ and Starting Age for Diagnostic Subgroups

Variable	LD		LD/SED		LD/OH	
FSIQ	97.4	(10.7)	100.6	(10.4)	94.6	(8.3)
Starting Age (mo.)	83.5	(13.1)	86.3	(11.9)	80.8	(9.3)
n	40		36		14	

Note. *SD* in parentheses

Table 3

Mean Key Math (KM) and Woodcock Reading (WC) scores for the Diagnostic Subgroups as a Function of Time of Measurement

Achievement Test	Time of Measurement	Subgroup: LD	LD/SED	LD/OH
KM	2	2.2 (.78)	2.6 (.80)	2.1 (.72)
KM	3	2.9 (.84)	3.2 (.91)	2.5 (.58)
KM	4	3.3 (.76)	3.9 (1.21)	3.2 (.63)
WC	2	1.5 (.44)	2.3 (1.15)	1.5 (.23)
WC	3	2.1 (.78)	2.9 (1.34)	2.0 (.61)
WC	4	2.6 (.82)	3.9 (1.74)	2.7 (1.15)

Note. *SD* in parentheses

Table 4

Diagnostic Categories from DSM-II and ICD#9 Used to Form Diagnostic Subgrouping Scheme

Subgroup	Diagnostic Category
LD/SED	Underachievement plus one of the following:
	Adjustment Reaction of Childhood[a,b]
	Withdrawn Reaction[a]
	Disturbance of Emotions[b]
	Disturbance of Conduct[b]
	Depressive Disorder[b]
	Other Behavior Disorders[a]
LD/OH	Underachievement plus one of the following:
	Hyperkinetic Reaction[a]
	Nonpsychotic OBS[a,b]
	Hyperkinetic Syndrome of Children[b]
LD	Underachievement plus one of the following:
	Specific Learning Disturbance[a]
	Specific Delays in Development[b]

Note. All children were performing at or below 75% of expected achievement. The expected level was based on age and IQ.
[a] DSM-II. [b] ICD#9.