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ABSTRACT

The authors discussed common approaches used to identify school children with learning difficulties, examined past studies on the prevalence of learning disabled school children, surveyed methodological and conceptual problems in identifying children with learning problems, and presented recommendations for future prevalence studies. Prevalence projections of learning disabled children in various elementary school populations were discovered to range from approximately 1 to over 30%. Surveys using achievement expectancy formulas were found to report lower percentages (between 4 and 15%) than speculative estimates by authorities and studies of children achieving below grade level. Differences in defining criteria, instrumentation, methods of analysis, characteristics of samples, and quality and extent of instructional history were thought to account for the wide variations in the characteristics of children with reported learning difficulties. Recommendations such as the following were offered: variables should be selected for possible inclusion into prediction equations which minimize potential content overlap between the predictors and the achievement measures, and the criterion of disparity between predicted and actual achievement should vary according to the length of time the students have been exposed to systematic instruction. (GW)

RESEARCH REPORT NO. 20

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PREVALENCE OF LEARNING DISABILITIES: FINDINGS, ISSUES, AND RECOMMENDATIONS [1,2]

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Department of Health, Education, and Welfare
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ABSTRACT

An important educational problem is accurately determining the proportion of school children with learning problems who are in need of specialized assistance. This paper reviews findings of available prevalence studies of children with reading disabilities and discusses several persistent methodological and conceptual problems inherent in several commonly used approaches to identify children with academic learning problems. Recommendations are also presented for the conduct of future survey studies of learning disabled children.

PREVALENCE OF LEARNING DISABILITIES: FINDINGS, ISSUES, AND RECOMMENDATIONS[1,2]

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A recent upsurge of interest in the child with learning disabilities, stimulated largely by parents, educators, and legislators, has led to the passage of state and federal laws to establish special developmental and corrective instruction programs. Even though such programs for children with learning problems are growing apace, little data are yet available on the true extent of need in this educational area. Few current prevalence estimates of children with school learning problems are supported by findings from empirical studies. Moreover, comparisons among available studies are complicated by the fact that investigators have employed a variety of criteria, techniques and instruments to identify the presence of learning difficulties among school aged children.

The purposes of this paper are (1) to discuss common approaches employed to identify the presence of learning problems in school children, (2) to examine the findings of past studies designed to determine the prevalence of school children with difficulties in learning, (3) to survey methodological and conceptual problems in identifying children with learning problems, and (4) to present recommendations for the conduct of future survey studies of learning disabled children.

Definitions

Statements defining the nature of learning problems among children are both numerous and varied (cf. Chalfant & Scheffelin, 1969; Myers & Hammil, 1969). The search for clarity of definition is impeded by the abundance of terms which have been used to characterize inadequate academic development. Terms such as learning difficulties, learning disorders, learning disabilities are frequently used interchangeably with reading disorders, retarded readers, remedial readers, reading disability, minimal brain dysfunction, etc.

A distinction is often made in definitions between children with learning difficulties and those with learning disabilities (Samuels, 1970). The term learning difficulties is applied in a generic sense to children whose academic achievement is appreciably below what could be predicted on the basis of age and/or indices of learning ability (e.g., measures of intelligence).

As defined in the Specific Learning Disabilities Act of 1969 (Public Law 91-230), "the term 'children with specific learning disabilities' means those children who have a disorder in one or more of the basic psychological processes involved in understanding or in using language...which...may manifest itself in imperfect ability to listen, think, speak, write, spell, or do mathematical calculations.... Such a term does not include children who have learning problems which are primarily the results of visual, hearing, or other motor handicaps, of mental retardation, of emotional disturbance, or of environmental disadvantage (Ladd, 1971, p. 383)."

The primary difference between definitions of learning difficulty and learning disability is that those with a disability emphasis specifically exclude children whose learning problems are associated with sensory and motor impairments and/or limitations in experiential background, while those with a difficulty orientation merely establish a criterion for poor achievement.

The common denominator of both conceptualizations of school learning problems is the concept of discrepancy between an estimate of learning potential and the child's actual achievement. Most of the findings reviewed in the following section were derived from studies of school children in the United States which adhered to a difficulty rather than disability orientation.

Findings

Prevalence studies of learning difficulties or disabilities in school populations can be classified generally into three broad categories: (a) estimates in the form of speculative projections by leading specialists in academic skill development, (b) estimates based upon achievement prediction (expectancy) formulas, and (c) estimates which assess the prevalence of children achieving at specified levels below grade placement. (Most of the reported prevalence estimates of children with learning difficulties have been in the area of reading. Thus far we have found few reports of studies in mathematics or other academic skill areas.)

Prevalence estimates of children with severe learning difficulties by leading authorities in academic skill development are rather consistent, ranging mostly from 10 to 15 percent of the school population (see Table 1).

Insert Table 1 about here

A recent estimate by McCarthy and McCarthy (1969) of five to ten percent of the school population is understandably lower, since it is a projection of the rate of children with learning disabilities, rather than those with learning difficulties.

Only a few studies have used achievement prediction (expectancy) formulas to assess the prevalence of children with learning difficulties (see Table 2). Estimates derived from studies appear slightly lower than those provided by leading authorities, generally ranging from approximately four to 14 percent. In two comprehensive studies (Myklebust, 1968; Rocky Mountain Educational Laboratory, 1969), elementary school children in grades two through four identified as poor achievers were administered further diagnostic tests to ascertain those children who met criteria contained in definitions of learning disabilities. The prevalence of children with learning difficulties was approximately 14 percent; about four to five percent of the children in these samples exhibited severe learning disabilities.

Insert Table 2 about here

Achievement below grade level is by far the most common criterion used to survey school populations for children with academic learning problems. Prevalence estimates from these studies vary widely from a low of .001 percent to a high of 28 percent (see Table 3).

Insert Table 3 about here

(The study reporting the lowest percentage of cases was concerned with identifying the frequency of dyslexic cases among a sample of sixth grade children.) The wide variations in estimated prevalence of learning problems among studies reported in Table 3 appear largely due to differences in populations and instruments used to assess academic achievement. As expected, studies in large urban centers report the highest rates of learning problems, sometimes in excess of 25 percent of the school population.

Conclusions. Prevalence projections of learning difficulties in various settings of elementary school populations appear to range widely from approximately one to over 30 percent. Surveys using achievement expectancy formulas generally report lower percentages (between 4 and 15 percent) than speculative estimates by authorities and studies of children achieving below grade level. Only one-third of a group of children with learning difficulties appear to exhibit the characteristics specified in prevailing definitions of learning disability.

The potpourri of samples, instruments, defining criteria and methods employed in studies assessing the prevalence of learning disabilities in school populations present a perplexing pattern of results. Part of the confusion in findings is due to an apparent failure by investigators to consider the possibility that the different methods of conducting prevalence surveys may yield different results--both in terms of the proportion and characteristics of children identified as learning disabled. Some of the hazards of interpreting existing prevalence estimates are illustrated by a brief review of common approaches to surveying school populations for poor achieving children and the findings of a study we recently completed in which several survey methods were applied to approximately 2500 third and sixth grade children.

Issues

Several approaches have been recommended for identifying children with academic learning problems. Most authors recommend the use of measures of intelligence or listening comprehension to establish expected levels of achievement (cf. Della-Piana, 1968; Neville & Bruininks, in press; Otto & McMenemy, 1966; Strang, 1964; Wilson, 1967). The most common achievement expectancy formulas include indices of intellectual ability which are often weighted for the length of time a child has been exposed to instruction. A few of the more popular achievement expectancy formulas are listed in Table 4.

Insert Table 4 about here

Important to recognize is that available formulas do not yield identical levels of expected achievement for the same children, particularly for children at the extreme ends of the intellectual continuum (McLeod, 1968; Neville & Bruininks, in press; Simmons & Shapiro, 1968; Ullmann, 1969). In Figure 1 achievement predictions computed by four of the expectancy formulas in Table 4 are illustrated for children

Insert Figure 1 about here

with IQ scores of 75 between the ages of six and 12 years. This Figure indicates that the Mental Grade (mental age) method gives the lowest estimates of expected achievement at age six, while it estimates intermediate achievement for older children. The Horn and Myklebust formulas provide intermediate achievement estimates at age six, but at approximately age eight these formulas begin to yield divergent predictions. The Horn formula expectancies become parallel with and slightly lower than the Bond and Tinker projections. Expectancies from the Myklebust formula yield the most conservative estimates between 8 and 12 years. The Bond and Tinker formula provides the highest estimates of achievement expectancy throughout the age range of 6 to 12 years.

A somewhat different pattern of achievement expectancies emerges for children with IQs of 125 within the same age range (see Figure 2).

Insert Figure 2 about here

Unlike the results obtained for lower IQ children, the Mental Grade approach consistently yields the highest estimates of expected achievement for children with high IQs. Except at the lowest ages, the Horn and Bond and Tinker formulas yield somewhat lower projections than the Mental Grade method, while the estimates of the Myklebust formula generally produce the lowest predictions of expected achievement

Clearly, these and other achievement expectancy formulas do not necessarily identify the same number or type of school children as learning disabled. To investigate this issue further, six common approaches used to identify poor achieving children were applied with large samples of third and sixth grade children from a medium size Midwestern city (population of 100,000). The city is heterogeneous in terms of common socioeconomic status indices, and approximately ten percent of the school population is comprised of children from minority groups. Mean IQ and achievement test scores of the samples at both grade levels were slightly above the norms for children of comparable chronological ages (see Table 5).

Insert Table 5 about here

Since test data were not available on special class populations, no analyses were conducted with children with IQ test scores below 80 on the Lorge-Thorndike Intelligence Tests (Lorge, Thorndike & Hagen, 1962). (These children were excluded because it was felt that the absence of test scores on special class populations might yield unrepresentative findings for children with IQs below 80.) The Lorge-Thorndike Intelligence Tests (Lorge, Thorndike & Hagen, 1962) and the reading comprehension and arithmetic computation subtest of the Iowa Tests of Basic Skills (Lindquist & Hieronymus, 1964) were used as measures of intelligence and achievement. The tests were administered to both third and sixth grade children in March of the same year (grade level = 3.7 and 6.7 respectively). Only the results of the reading tests analysis are discussed in this paper.

Five of the survey approaches used in the study were achievement expectancy formulas which include measures of experience (age, years in school) and/or intelligence test scores (IQ or MA). The sixth approach used the criterion of years below grade level tr ' . the presence of a learning problem. One grade or more below expected achievement was used to identify children with learning problems in the third grade; two or more grades below expected achievement was used to define the presence of a learning problem at the sixth grade level.

The prevalence of third grade children exhibiting learning problems varied widely as a function of survey techniques and type of IQ test (verbal or nonverbal) used in the five achievement expectancy formulas. Using a nonverbal intelligence test score, the percentage of poor achieving third grade children ranged from 16.1 percent with the Bond and Tinker formula to 54.6 percent for the formula using mental age alone (see Table 6). The rates of poor reading children with the Horn,

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Insert Table 6 about here

Monroe, and Myklebust formulas were similar. However, using verbal IQ scores in the five formulas yielded highly similar, but more conservative estimates of the prevalence of children with reading problems. The rates ranged from a low of 11.7 percent to a high of 16.7 percent.
(The lower rates for the verbal tests reflect the fact that these

sco: :s are more highly related to reading achievement scores. Moreover, considerabl. . . . at overlap exists between the intelligence and reading test scores since the Lorge-Thorndike Verbal Tests require reading to respond.)

The findings at the sixth grade level were similar to the pattern of results obtained with achievement expectancy formulas at the third grade level. However, proportionately fewer sixth grade than third grade children were identified as poor readers.

The prevalence rates of poor achieving children reading below grade placement was lower than the estimates obtained through the use of expectancy formulas (see Table 7). The percentage of retarded readers

Insert Table 7 about here

at the third grade level was 15.5 percent; the rate at the sixth grade level was 7.2 percent. It is not surprising that fewer children were identified with learning difficulties by the below grade level method, however, since the samples were slightly above average in intelligence and achievement test performance. Prevalence rates with all methods are probably inflated due to above average ability and achievement levels of the sample and the tendency to over-report the number of children with learning problems through the use of group achievement tests. Further diagnostic testing in reading would have undoubtedly reduced the number of children meeting the criteria established for poor achievement.

Comparisons were also made of achievement and intelligence test results for poor readers as identified by the various prediction formulas (see Tables 8 and 9). At both third and sixth grade levels,

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Insert Tables 8 and 9 about here

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retarded readers identified by the mental age approach with either verbal or nonverbal IQ scores averaged considerably higher in performance on measures of reading, arithmetic, and verbal and nonverbal intelligence than poor readers surfaced by the other expectancy formulas. Using nonverbal IQs as a measure of expectancy identified more children with above average IQs and achievement test scores than when verbal IQs were employed to predict achievement potential.

Intelligence and achievement test scores of poor readers identified by the Horn, Monroe, and Myklebust formulas were quite similar. The Bond and Tinker formula, however, generally identified groups as poor readers with the lowest achievement and intelligence test scores. Mean nonverbal IQ scores of poor readers across the five approaches ranged from approximately 94 to 119 when nonverbal IQ scores were used to predict achievement expectation. Verbal IQs for the same groups were about 10 points lower than nonverbal IQ scores. Using verbal IQ scores to predict achievement expectations yielded groups with lower intelligence and achievement test scores.

Finally, children scoring below the established criterion of acceptable performance in reading tended to achieve approximately one or more grade levels higher in arithmetic computation than in reading skills. This suggests that for most children with learning problems, academic skill deficiencies are specific to rather than generalized across particular skill areas.

Discussion and Recommendations

What do all of these findings and those of previous studies mean for general practitioners charged with the responsibilities of either identifying poor achieving children or determining the prevalence of children with learning disabilities in school populations? Analysis of available prevalence studies has led us to the following conclusions:

(1) It is obvious that determining the prevalence of learning disabled children in need of special education assistance is a task of enormous complexity. Simple statements of prevalence often obscure the true nature and extent of need for services in school populations. Reported findings are frequently artifacts of differences in samples, defining criteria, instrumentation, and methods employed to identify underachieving children.

(2) Translating statements of prevalence into direct estimates of service need is nearly impossible. The fact that a certain proportion of the school population exhibits achievement scores below expected levels is hardly surprising. Such a state of affairs merely reflects our inability to predict achievement accurately (Thorndike, 1963). As Thorndike (1963) has noted, achievement below expectancy can be called overprediction as logically as it can be termed underachievement.

The entire notion of viewing scores from intelligence tests as measures of a child's capacity to achieve is of dubious value (McLeod, 1968). Viewing one measure as a measure of capacity for another is illogical unless the two assessments either result from the same instrument or are perfectly correlated (McLeod, 1968). We are predicting achievement from aptitude, not determining the child's capacity to achieve. Since correlations between measures of aptitude and achievement do not indicate causal explanations for school failure, achievement test scores might reflect the child's capacity to perform on IQ tests as logically as IQ scores reflect the limit of a child's ability to achieve.

(3) Application of achievement expectancy formulas to school populations increases the likelihood of identifying as poor achievers many children who merely represent errors in measurement. The common ingredient of existing formulas is the derivation of a difference between an aptitude score and a measure of achievement. A longstanding research axiom is that persons scoring high or low on one measure will likely yield less extreme scores by chance alone on another measure. Our findings suggest that the mental age approach particularly capitalizes upon statistical regression, thereby identifying as learning disabled unknown numbers of children who merely exemplify measurement errors. The practice using mental age as a criterion of expected achievement should be replaced by measures like the Bond and Tinker formula which at least take into account the length of time a child has been exposed to instruction (Neville & Bruininks, in press).

A related problem in the use of expectancy formulas is the reliability of the difference scores produced by subtracting expected from actual achievement. Difference scores are ordinarily substantially less reliable than the test scores from which they have been derived (Thorndike, 1963; Thorndike & Hagen, 1961). To use a hypothetical example, if the reliabilities of the achievement and IQ tests are 0.90 and the intercorrelation between them is 0.80, the reliability of the difference score is only 0.50. With difference scores of such low reliability, prevalence studies reporting the extent of learning difficulties in school populations undoubtedly contain a large number of "false positives."

(4) Expectancy scores may have some usefulness in surveying populations of children, but they are virtually useless as indices for making educational decisions (Reynolds, 1965). They neither indicate the nature of the child's difficulty nor provide any indication of what educational strategy is suitable for dealing with the child's problem. In short, a difference between expected and actual achievement may indicate the presence of a difficulty, but it does not provide an index of a child's ability to profit from tuition under different instructional programs.

(5) Some studies have employed a fixed number of years below grade level as a criterion to define the presence of a learning disability. Application of this approach to school populations automatically leads to an artificial increase in the prevalence of learning disability with age (Ullmann, 1969). (See study #7 in Table 3 for an illustration of this point.) The fixed difference approach for varying grade levels also assumes that increments are constant in academic growth across grade levels. This assumption has no basis in fact, since growth of academic skills with age typically assumes the shape of a negatively accelerating rather than a linear curve (Simmons & Shapiro, 1968).

The following recommendations are being offered for conducting future prevalence surveys of learning disabled children:

(1) Choice of achievement expectancy formula to identify learning disabled children or to conduct prevalence surveys should depend primarily upon the purposes of the study (e.g., proportion and character-

istics of children to be served, etc.). If the investigator wishes to surface underachieving gifted children, for example, he should employ a technique which has greater discriminability within this subgroup. A far better approach in identifying poor achieving children, however, is through the technique of statistical regression (cf. Silberberg & Silberberg, 1969; Thorndike, 1963). This approach is based upon the relationships between one or more predictors (aptitudes, etc.) and a measure of achievement within particular populations. It has the advantage over general expectancy formulas as it maximizes the relationship between expectancy predictions and measures of achievement, and it minimizes errors of measurement by insuring that they are uncorrelated with either the predictor or criterion measures. One simple caveat should be considered in using the regression approach to establish achievement expectancies: variables should be selected for possible inclusion into prediction equations which minimize potential content overlap between the predictors and the achievement measures. This poses a dilemma for persons in search of effective survey techniques. As Thorndike (1963) has noted:

> We need a measure of potential that bears some substantial relationship to our index of achievement. However, the measure of potential should not include within itself any of the specific components of the achievement measure... (p. 52).

This is a particularly important consideration in using intelligence tests as measures of expected achievement. Well-validated empirical findings show that underachievers do poorly on most verbal measures of intelligence (Neville & Bruininks, in press).

(2) Future prevalence studies must not only avoid serious methodological problems, but they should also employ more precise definitions of learning difficulties or learning disabilities. In a recent article on the "not so specific learning disability population," Adelman (1971) poses a typology which includes three classifications of children with learning problems, based upon the nature and severity of the child's problem.

(3) More information on the educationally-relevant characteristics of children with learning disabilities is also clearly needed. The identification of specific subgroups in this diffuse population is necessary to insure that estimates of service need bear some meaningful relationship to aspects of program planning. Since learning difficulties result as much from instructional factors as from the learning characteristics of children (Adelman, 1971), prevalence reports must also contain descriptions of the instructional history of their samples.

(4) To avoid an artifactual increase with age in the prevalence of learning disabilities, surveys of school populations involving several grade levels should vary the criterion of disparity between predicted and actual achievement according to the length of time the children have been exposed to systematic instruction.

(5) Prevalence surveys of children with learning difficulties are concerned with comparing a child's relative standing in achievement against a representative sample of children of similar ages, training, and/or ability levels. An emerging alternative to this procedure is the criterion-referenced approach to test interpretation (Prescott, 1971). With the criterion-referenced approach, test scores represent the child's attainment of specific academic skills within a particular teaching

program, rather than his standing compared to a representative group of children. Since universal skill hierarchies or task analyses in academic subjects are not yet available (Samuels, 1970), applying widely the criterion-referenced approach in assessing the extent and nature of learning problems among school children is not possible. It is recommended, however, that this approach be given serious consideration as a supplement to norm-referenced analyses in planning future surveys of learning disabled children. Criterion-referenced assessment does offer the potential of providing information on the precise nature of the difficulties present in learning disabled populations.

(6) Campbell and Stanley (1963) have made a distinction between internal validity and external validity factors in educational experiments which appears pertinent to the conduct of prevalence surveys of school populations. Sources of internal validity refer to factors which, if uncontrolled, may influence the outcome of an experiment and render its findings invalid. External validity factors encompass a class of extraneous variables which limit the generalizability of findings to other settings and populations.

The following checklist of questions is proposed as an attempt to create greater awareness of some of the primary internal and external validity factors which must be considered in interpreting and generalizing the findings of prevalence studies of learning disabled children.

Questions of Internal Validity*

(1) Could the results of the survey be influenced greatly by the instructional history of the sample?

* Affirmative responses to questions 1 through 3 and negative responses to questions 4 through 9 are evidence of threats to the internal validity of the survey.

(2) Did measures of learning potential excessively overlap in content with the achievement measure(s)?

(3) Did the aptitude measures require reading for response?

(4) If a wide age range of children was sampled, were different criteria used at each year level to define the presence of a learning problem?

(5) Were aptitude and achievement tests initially standardized on representative school populations?

(6) Were the measures employed in the study reliable and valid indices of aptitude and achievement?

(7) Did the survey method minimize the likelihood that statistical regression would unduly contribute to the results of the study?

(8) Had the survey method been previously cross-validated on several different school populations?

(9) Did the study use the technique of regression instead of conventional expectancy formulas or years below grade level to identify poor achievers?

Questions of External Validity*

(1) Did the study include an adequate description of both the characteristics of the sample and the teaching approaches being used to develop mastery in academic subjects?

(2) Were the teaching methods used to develop academic mastery similar to those employed in other school systems?

(3) Were the children generally representative of other school populations in terms of general aptitude patterns, achievement levels, socioeconomic status, etc.?

* Negative responses to questions 1 through 6 jeopardize the generalizability of the survey's findings to other school populations and settings.

(4) Did the study report the characteristics of children identified as learning disabled?

(5) Did the study report any information on the characteristics of teachers in charge of instructing the children?

(6) Were the survey results cross-validated with other similar school populations?

Concluding Statement

This paper has focused ostensibly upon discussing factors which influence estimates of the proportion of children with learning difficulties or learning disabilities. A confusing picture emerges after one examines the results of prevalence studies of children with learning problems in general school populations. The wide variation in the proportion and characteristics of children with learning disabilities or learning difficulties reported in prevalence studies may be ascribable to the influence of several important factors, including differences in defining criteria, instrumentation, methods of analysis, characteristics of samples, and quality and extent of instructional history.

A statement made over 50 years ago by Sir Josiah Stamp seems a somewhat appropos interpretaion of the confusing findings on the prevalence of learning disabilities in school populations:

> The government is very keen on amassing statistics. They collect them, add them, raise them to the Nth power, take the cube root and prepare wonderful diagrams. But you must never forget that everyone of these figures comes in the first instance from the village watchman, who just puts down what he pleases.

The reports of our "village watchmen" must be more carefully scrutinized if prevalence estimates are to be used in support of calls to expand programs for children with severe learning difficulties.

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Footnotes

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[2] Paper presented at the 49th Annual International Convention of the Council for Exceptional Children, April, 1971.

TABLE 1

Speculative Prevalence Estimates of

Children with Learning Difficulties[a]

Source	Prevalence Estimate
Betts (1936)	12.0-15.0%
Monroe (1938)	8.0-15.0%
Durrell (1940)	15.2%
Smith and Carrigan (1959)	15.0%
Harris (1961)	10.0-15.0%
HEW Advisory Committee on Dyslexia and Related Reading Disorders	15.0%
McCarthy and McCarthy (1969)	5.0-10.0%

[a]Speculative estimates generally do not report specific information on samples, defining criteria or achievement measures.

Illustrative Prevalence Studies Using Prediction Formulas to Identify Children with Learning Difficulties

Study	Sample(s)	N	Method(s)	Defining Criteria	Measures	Prevalence Estimate
1. Bruininks and Weatherman (1970)	1.a) Third grade rural and urban children in Minnesota	1356	1. Bond & Tinker formula	1.a) 1 grade below	Lorge-Thorndike Iowa Tests of Basic Skills	1.a) 6.1%
	b) Sixth grade rural and urban children in Minnesota	1823		b) 2 grades below		b) 5.8%
2. Myklebust (1968)	2. Third and fourth grade in middle and upper middle class area	932	2. Myklebust formula	2.a) Underachievers (Learning quotient below 90)	Primary Mental Abilities	2.a) 14.5% learning difficulties
				b) Learning disabled (selected from underachievers)	Metropolitan Achievement Tests	b) 3.8% learning disabilities
3. Hodges, *et al.* (1969)	3. Fourth through seventh grade children in 12 school systems in rural central Georgia	11,311	3. Bond & Tinker formula	3. More than 1 year below expected achievement levels	Within 12 school systems: Calif. Achievement Tests, Metropolitan Achievement Tests, Stanford Achievement Tests, Iowa Basic Reading Achievement, Calif. Tests of Mental Maturity, Otis Quick Scoring Mental Abilities Tests, Henmon-Nelson Tests of Mental Abilities	3. 25.0%
4. Rocky Mountain Educational Laboratory (1969)	4. Second grade children in an 8 state region	2400	4. Myklebust formula	4.a) 2 years below on classroom screening instrument	Monroe Reading Aptitude Tests	4.a) 14.0%

ıble 2: continued.

Study	Sample(s)	N	Method(s)	Defining Criteria	Measures	Prevalence Estimate
				b) 2 years below and educational diagnosis	Gates-McKillop Reading Diagnostic Test Wechsler Intelligence Scale for Children	b) 6.0% less severe disabilities
				c) 2 years below and medical diagnosis	Peabody Picture Vocabulary Test	c) 4.7% severe learning disabilities
5. HEW Report on Reading Disorders in the U.S. (1969)	5. All children in public schools in Montgomery County, Maryland (upper middle class area)	NR[a]	5. Derived formula	5. Underachievers	Lorge-Thorndike Intelligence Test (Verbal) Iowa Tests of Basic skills	5. 13.3%

[a]Not reported.

TABLE 5

Illustrative Prevalence Studies Using Years Below Grade Level Criterion

to Identify Children With Learning Difficulties

Study	Sample	N	Defining Criteria	Measures	Prevalence Estimate
1. Bruininks and Weatherman (1970)	1. a) Third grade rural and urban children in Minnesota	1356	1. a) 1 year below	Iowa Tests of Basic Skills	1. a) 6.7%
	b) Sixth grade rural and urban children in Minnesota	1823	b) 2 years below		b) 3.4%
2. Newbrough and Kelly (1962)	2. Sixth Grade children in Langley Park, Md.	3946	2. 2 years below	California Achievement Tests	2. 14.0%
3. Eisenberg (1966)	3. a) Sixth grade children in large eastern U.S. city (metropolis)	12,000	3. a) 2 or more years below	a) Stanford Achievement Tests--Group IQ Test	3. a) 28.0%
	b) Sixth grade children in suburbia just outside metropolis	8000	b) 2 or more years below	b) Iowa Tests of Basic Skills	b) 3.0%
	c) Sixth grade children in commuter county outside metropolis	NR[b]	d) 2 or more years below	c) California Achievement Tests	c) 15.0%
	d) Sixth grade children in private schools in metropolis	200	d) 2 or more years below	d) Stanford Achievement Tests	d) 0.0%
4. Mangrum (1969)	4. Sixth grade children in a Southern city	634	4. a) Dyslexic:[a] 2 or more years below	Iowa Tests of Basic Skills Reading Subtest of Wide Range Achievement Test	4. a) .035%

			b) Dyslexic: 4 or more years below	Wide Range Achievement Test PPVT	b) .001%
5. HEW Report on Reading Disorders in the United States (1969)	5. a) Third and fourth grade children in Appleton, Wisconsin and 17 neighboring communities	4056 total	5. a) 1 year below at third and fourth grades	Gates McGinitie WISC	5. 11.8%
	b) Fifth and sixth grade children in Appleton, Wisconsin and 17 neighboring communities	(IQ > 80)	b) 2 years below		
6. HEW Report on Reading Disorders in the United States (1969)	6. Grades 2,4,6,8 and 10	36,791	6. a) 1 to 2 years below	NR[b]	6.a) 6.6%
			b) more than 2 years below		b) 7.5%
7. HEW Report on Reading Disorders in the United States (1969)	7. Children between the ages of 9 and 11 years: a) 9 year olds b) 10 year olds c) 11 year olds	7000	7. 2 years below	NR[b]	7.a) 12.0% of 9 year-olds b) 16.0% of 10 year-olds c) 25.0% of 11 year-olds

[a]Children defined as dyslexic if reading poorly, but with adequate intelligence, motivation, normal sensory acuity, and no evidence of emotional disturbance and cultural deprivation.

[b]Not reported.

TABLE 4

Commonly Used Achievement Expectancy Formulas

Formulas			
1. Mental Grade	AE[a]	=	MA - 5 years
2. Bond and Tinker (1967)	AE	=	$(\frac{IQ}{100} \times \text{years-in-school}) + 1.0$
3. Monroe (1932)	AE	=	$(\frac{\text{Arithmetic Age} + CA + MA}{3} - 6) + 1.0$
4. Horn (1944)	AE (age:6-0 to 8-5)	=	$(\frac{MA + CA}{2} - 6) + 1.0$
	AE (age:8-6 to 9-11)	=	$(\frac{3MA + 2CA}{5} - 6) + 1.0$
	AE (age:10-0 to 11-11)	=	$(\frac{2MA + CA}{3} - 6) + 1.0$
	AE (age: 12-0+)	=	$(\frac{3MA + CA}{4} - 6) + 1.0$
5. Myklebust (1968)	AE	=	$\frac{MA + \text{Grade Age}}{2}$

[a] Achievement expectancy.

TABLE 5

Descriptive Statistics on Third- and Sixth-Grade Children[a]

Groups	CA[b]		Verbal IQ		Verbal GE[c]		Nonverbal IQ		Nonverbal GE[c]		Reading GE[c]		Arithmetic GE[c]	
	$\overline{X}$	s	$\overline{X}$	s	$\overline{X}$	s	$\overline{X}$	s	$\overline{X}$	s	$\overline{X}$	s	$\overline{X}$	s
Third Grade														
Boys (N = 720)	109.13	7.14	101.19	14.80	3.90	1.01	106.18	16.64	4.67	1.70	3.84	1.20	4.06	0.87
Girls (N = 691)	107.73	6.23	106.70	13.74	4.25	1.01	110.40	14.69	5.02	1.59	4.19	1.12	4.16	0.83
Total (N = 1411)	108.45	6.74	103.89	14.56	4.07	1.03	108.25	15.86	4.84	1.66	4.01	1.17	4.11	0.85
Sixth Grade														
Boys (N = 619)	144.82	8.23	104.61	13.88	7.24	1.63	111.06	15.12	8.27	2.13	6.65	1.49	6.93	1.29
Girls (N = 602)	143.45	7.63	107.34	12.75	7.47	1.51	113.20	13.71	8.47	1.96	6.87	1.34	6.86	1.27
Total (N = 1221)	144.14	7.97	105.96	13.40	7.35	1.58	112.12	14.48	8.37	2.06	6.76	1.42	6.90	1.28

[a] The computations in this Table include the scores of 108 third and 38 sixth grade children who were deleted because they had either verbal or nonverbal IQ scores below 80 on the Lorge-Thorndike Intelligence tests.

[b] In months.

[c] Grade equivalent.

TABLE 6

Number and Prevalence of Third- and Sixth-Grade Children Identified with Disabilities in Reading Achievement using Different Test/Method Combinations

Group/IQ Test	Mental Grade		Monroe		Horn		Myklebust		Bond and Tinker	
	N	%	N	%	N	%	N	%	N	%
Third Grade-Nonverbal IQ[a]										
Boys (N = 636)	352	27.0	184	14.1	223	17.1	169	13.0	126	9.7
Girls (N = 667)	359	27.6	124	9.5	172	13.2	138	10.6	83	6.4
Total (N = 1303)	711	54.6	308	23.6	395	30.3	307	23.6	209	16.1
Third Grade - Verbal IQ[a]										
Boys (N = 636)	111	8.5	114	8.7	129	9.9	89	6.8	94	7.2
Girls (N = 667)	107	8.2	70	5.4	88	6.8	64	4.9	69	5.3
Total (N = 1303)	218	16.7	184	14.1	217	16.7	153	11.7	163	12.5
Sixth Grade-Nonverbal IQ[a]										
Boys (N = 597)	298	25.2	100	8.4	195	16.5	122	10.3	85	7.2
Girls (N = 586)	300	25.4	55	4.6	166	14.0	88	7.4	51	4.3
Total (N = 1183)	598	50.6	155	13.0	361	30.5	210	17.7	136	11.5
Sixth Grade - Verbal IQ[a]										
Boys (N = 597)	100	8.4	47	4.0	58	4.9	49	4.1	43	3.6
Girls (N = 586)	104	8.8	23	1.9	43	3.6	28	2.4	24	2.0
Total (N = 1183)	204	17.2	70	5.9	101	8.5	77	6.5	67	5.6

[a] Refers to test score used in achievement expectancy formula.

TABLE 7

Number and Prevalence of Third and Sixth Grade Children Below Grade Level in Reading[a]

Group	N	%
Third Grade		
Boys	132	10.1
Girls	70	5.4
Total	202	15.5
Sixth Grade		
Boys	54	4.6
Girls	31	2.6
Total	85	7.2

[a]Children were identified as poor achievers if they performed one or more grades below placement in the third grade and two or more grades below placement in the sixth grade.

TABLE 8

Mean Achievement and IQ Scores on Children with Reading Disabilities

Identified by Different Test/Method Combinations

	Mental Grade			Monroe			Horn			Myklebust			Bond & Tinker		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
Third Grade - Nonverbal IQ[a]															
Reading Grade Level	4.0	4.2	4.1	2.9	3.0	2.9	3.1	3.2	3.1	3.0	3.2	3.1	2.5	2.5	2.5
Arithmetic Grade Level	4.4	4.4	4.4	4.0	4.0	4.0	4.0	4.0	4.0	3.9	4.0	3.9	3.6	3.5	3.6
Verbal IQ	106.4	109.7	108.1	97.1	101.9	99.0	96.8	101.7	98.9	98.4	102.8	100.4	92.2	94.8	93.6
Nonverbal IQ	117.8	119.5	118.7	108.8	113.5	110.6	108.4	113.6	110.6	111.4	115.5	113.2	100.6	103.6	101.8
Number Identified	(351)	(358)	(709)	(183)	(123)	(306)	(222)	(170)	(392)	(168)	(137)	(305)	(125)	(83)	(208)
Third Grade - Verbal IQ[a]															
Reading Grade Level	3.0	3.6	3.3	2.4	2.5	2.4	2.5	2.5	2.5	2.3	2.3	2.3	2.3	2.3	2.3
Arithmetic Grade Level	3.9	4.2	4.0	3.7	3.7	3.7	3.6	3.6	3.6	3.5	3.5	3.5	3.5	3.4	3.5
Verbal IQ	105.1	113.2	109.1	95.1	99.7	96.8	93.4	97.3	95.0	95.7	99.9	97.4	94.0	99.1	96.2
Nonverbal IQ	106.7	112.3	109.4	99.6	103.4	101.0	99.0	102.7	100.5	98.7	103.6	100.7	98.0	100.4	99.0
Number Identified	(111)	(107)	(218)	(113)	(69)	(182)	(124)	(85)	(209)	(88)	(61)	(149)	(89)	(66)	(155)

[a] Refers to test score used in achievement expectancy formula.

TABLE 9

Mean Achievement and IQ Scores on Children with Reading Disabilities

Identified by Different Test/Method Combinations

	Mental Grade			Monroe			Horn			Myklebust			Bond & Tinker		
	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
<u>Sixth Grade</u> - Nonverbal IQ[a]															
Reading Grade Level	6.6	6.9	6.8	5.0	5.3	5.1	5.9	6.3	6.1	5.2	5.5	5.3	4.7	4.8	4.8
Arithmetic Grade Level	7.4	7.3	7.3	6.7	6.7	6.7	7.0	7.0	7.0	6.6	6.5	6.7	6.2	6.2	6.2
Verbal IQ	107.8	109.2	108.5	97.9	100.4	98.8	102.3	105.5	103.8	99.7	100.9	100.2	94.4	98.6	95.9
Nonverbal IQ	120.9	121.2	121.0	112.4	116.7	114.5	118.0	120.6	119.3	115.4	117.1	116.1	109.6	113.3	110.9
Number Identified	(296)	(299)	(595)	(99)	(54)	(153)	(195)	(166)	(361)	(121)	(87)	(208)	(85)	(49)	(134)
<u>Sixth Grade</u> - Verbal IQ[a]															
Reading Grade Level	6.6	6.8	6.7	4.3	4.2	4.3	4.6	5.1	4.8	4.2	4.1	4.2	4.1	3.8	4.0
Arithmetic Grade Level	7.4	7.3	7.3	6.3	6.2	6.3	6.1	6.4	6.2	6.0	5.9	6.0	5.8	5.5	5.7
Verbal IQ	116.2	118.4	117.3	96.0	98.0	96.6	99.7	107.2	102.9	97.0	98.2	97.4	92.8	94.5	93.3
Nonverbal IQ	117.4	118.7	118.0	105.1	105.8	105.3	106.1	110.3	107.8	105.8	105.0	105.5	102.2	105.8	103.3
Number Identified	(100)	(102)	(202)	(47)	(22)	(69)	(58)	(40)	(98)	(49)	(25)	(74)	(43)	(20)	(63)

[a]Refers to test score used in achievement expectancy formula.

Figure 1. Grade Level Predictions for Four Expectancy Formulas as a Function of Chronological Age and an IQ of 75

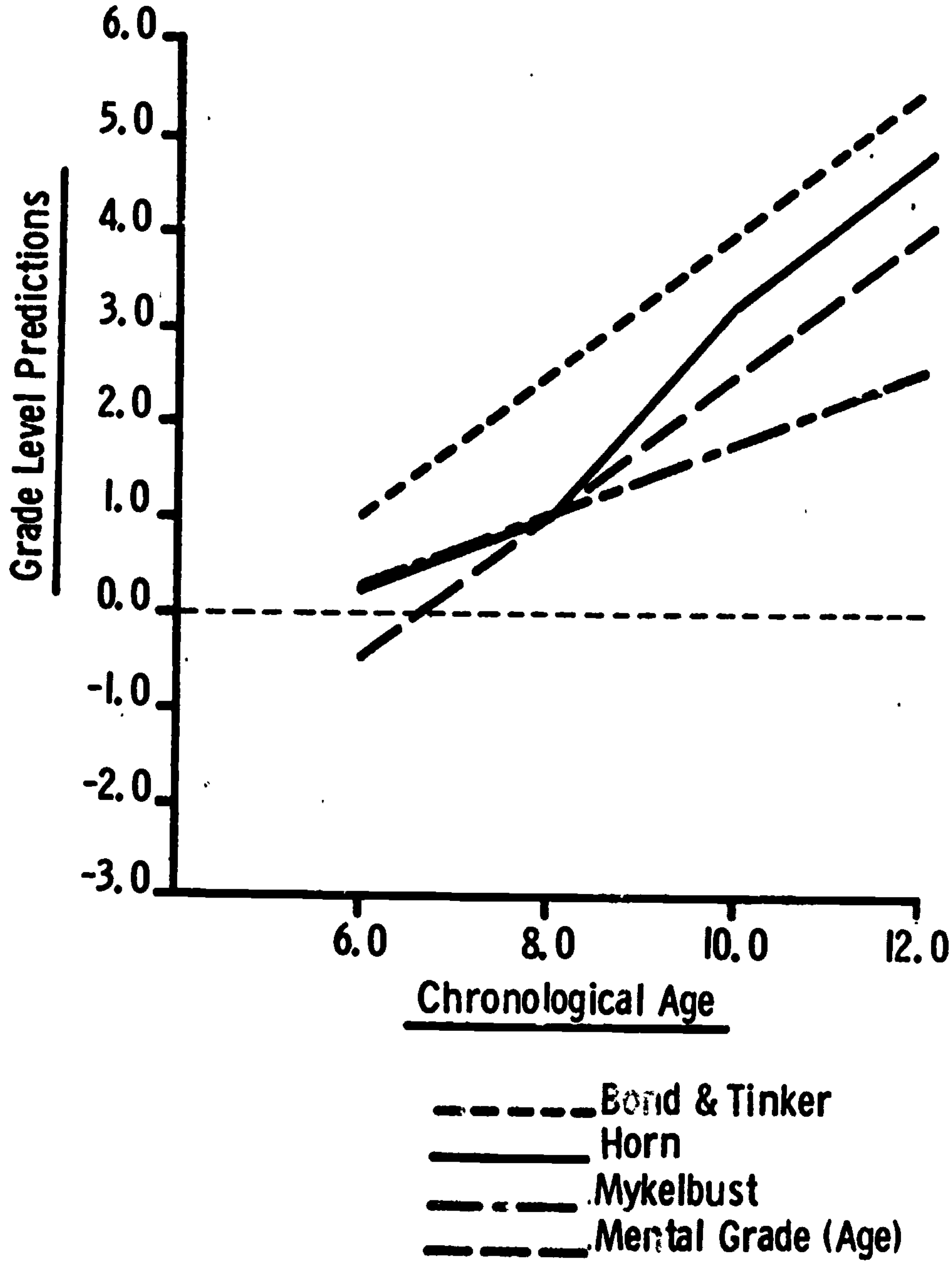

Figure 2. Grade Level Predictions for Four Expectancy Formulas as a Function of Chronological Age and an IQ of 125