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ABSTRACT

The paper reviews various types of definitions of learning disabilities and presents the specific operational definition that was used in a study involving 1,105 adolescents on the relationship between learning disability and juvenile delinquency. The definition of learning disability is analyzed in terms of its principal components, types of approaches used, and varying levels of conceptualization. The fundamental presumptions of the definition are discussed in terms of the variability in their interpretation. The central cause of the learning problem is then examined, the focus being placed on the variance in the types of areas stressed and the levels of conceptualization used to describe the nature of the cause. Various modes of classification are presented and exemplified in different remediational approaches. Against this background, the authors present the operational definition that was used in the study on learning disability and juvenile delinquency. First, the conditions under which data collection took place are discussed and the test data used in the study are presented. The paper then attempts to answer a series of questions using the data. Questions are directed toward analyzing how the measurement of the concept worked. Various factor analytic and correlation studies are discussed. (Author/SBH)

An Operational Definition of Learning Disability and its Application to a Study of Juvenile Delinquents

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Running head: An Operational Definition

Abstract

This paper reviews various types of definitions of learning disability, and presents the specific operational definition that was used in our study on the relationship between learning disability and juvenile delinquency.

The definition of learning disability is analyzed in terms of its principle components, types of approaches used, and varying levels of conceptualization. The fundamental presumptions of the definition are discussed in terms of the variability in their interpretation. The central cause of the learning problem is then examined, the focus being placed on the variance in the types of areas stressed and the levels of conceptualization used to describe the nature of the cause. Various modes of classification are presented and exemplified in different remediational approaches. Against this background, we present the operational definition that was used in the study on learning disability and juvenile delinquency. First, the conditions under which data collection took place are discussed and the test data used in the study are presented. The paper then attempts to answer a series of questions using these data. These questions are directed toward analyzing how the measurement of the concept worked. Various factor analytic and correlation studies are discussed.

An Operational Definition of Learning Disability and its Application to a Study of Juvenile Delinquents

This report covers a series of analyses that were conducted as part of a larger study directed toward understanding the possible link between learning disabilities and juvenile delinquency. To place the report in context, a review of the nature and purpose of the major study is in order.

Under a grant from the Office of Juvenile Justice and Delinquency Prevention of the Law Enforcement Assistance Agency, the Association for Children with Learning Disabilities and the Institute for Law, Business, and Social Research undertook to determine the relative prevalence of learning disabilities in two samples of 12- to 15-year-old boys -- those whose cases had been adjudicated and those whose cases did not contain court records.[1] The project also involved providing remedial academic treatment for a subsample of boys whose cases had been adjudicated and who were determined to be delinquent. This sample was later expanded to include both boys and girls from 12 to 16 years old.

The Institute for Law, Business, and Social Research subsequently contracted with Educational Testing Service to conduct psychoeducational diagnosis through pretesting of the youth in the study. This activity included the random assignments to remediation and control groups of all youth whose cases had been adjudicated and who were classified as learning disabled. An interim posttest was also administered to all remediation and control youth who participated in the study longer than one year, and final posttests were administered to all youth who completed a substantial portion of the remediation program. Youth who were assigned to the control group received a final posttest at approximately the same time.

The youth were diagnostically assessed at three locations: Baltimore, Indianapolis, and Phoenix. The determination of learning disabilities was based primarily upon the presence of pronounced discrepancies in performance on ability and achievement tests, supported by observations of behaviors thought to be associated with learning disabilities and by unusual error rates on a test of visual motor integration. The observations took place only during the testing period, which was approximately 3 1/2 hours long.

Three major concerns were addressed by the analyses: the adequacy of the tests for the purpose intended, the utility of the operational definition as a reasonable reflection of the presence of learning disabilities, and the effects of changes in the definition on the relative prevalence of learning disabilities in the two samples.

The analyses presented in this report were based on a total sample of 1,701 youths. The total sample was subdivided according to the requirements of each analysis.

In general, the investigation undertaken by the authors demonstrated that the tests were adequate for applying the definition in these samples. Although the data were not sufficient to unambiguously rule out certain competing hypotheses, the definition itself appeared to be a reasonable and useful interim definition that could be uniformly and systematically applied. Changes in prevalence estimates occurred with changes in the specifications of the decision rules. Changes in prevalence were largest when the rule changes involved ability level, but significant differences in prevalence between the public-school sample and the adjudicated delinquent sample remained after the changes were made.

The remainder of this repor[illegible]alyses that were run, the decision rules that were applied [illegible]iving a [illegible]lusions, the data that were considered and recommendations [illegible]additiona[illegible]search and analyses. Prior to the presentation of the an[illegible] the de[illegible]ion of learning disabilities will be reviewed.

The Problem of Definition

The general diagnostic l[illegible]el "le[illegible]ning disability" is applied to a wide range of disorders. Typically, the definition of the term is a function of the clinical or research concerns and orientation of the investigator. Even when theoretical agreement is present, changes in definitions are adopted more readily by some investigators than by others in the interest of clinical diagnoses and treatments or for use by governmental funding agencies (Johnson and Morasky, 1977). Lack of consensus is further compounded by the fact that the learning disability syndrome is not examined strictly within the boundaries of a single profession or discipline.

Although a number of disciplines have influenced the definition of learning disability, the demand for a functional definition has led to a general, if not unanimous, acceptance of a number of key elements. The basic concept of learning disability, as presented by the majority of the investigators, includes two fundamental conditions: (1) the existence of a learning problem, and (2) intellectual, physical, and emotional integrity.

Although there is general agreement among investigators as to the meaning of the term "learning problem," some variability in interpretation does exist. Most commonly, the term refers to academic achievement in arithmetic, spelling,

writing, and language, in addition to reading (Murray, 1976). The term "learning problem" is also interpreted, at times, to mean a difficulty not only in learning academic subjects but also in acquiring any skills that should normally develop from daily functioning in the environment (Valett, 1969). Although this type of definition is acceptable to some, most definitions in current use either state or imply that a problem may be labeled as one of learning disability only if it is relevant to educational development and performance.

The second most universally acceptable condition used for defining learning disability applies to the cause of the learning problem. Most definitions of learning disabilities state the causes of the learning problem which are to be included in the learning-disabilities category. According to Wepman, for example, a learning disability refers to "those children of any age who demonstrate a substantial deficiency in a particular aspect of academic achievement because of perceptual or perceptual-motor handicap regardless of etiology or other contributing factors" (Wepman et. al., as reported in Murray, 1976, p. 5). Several other definitions are more specific in their statement of inclusive and exclusive causes. For example, according to the Congressional definition as recommended by the National Advisory Committee on Handicapped Children (1968),

> Children with special learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written language. These may be manifested in disorders of listening, thinking, talking, reading, writing, spelling or arithmetic. They include conditions which have been referred to as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia, etc. They do not include learning problems which are primarily due to visual, hearing, or motor handicaps, to mental retardation, emotional disturbance, or to environmental disadvantage. (Lerner, 1976, p. 9; Knights and Bakker, 1975, p. 20)

Thus, there exists a standard assumption of physical, intellectual, and emotional integrity of the learning disabled child.

Not all investigators, however, adhere to the general principle of physical, intellectual, and emotional integrity. Perhaps the condition of physical integrity is the most acceptable one, particularly since different remedial techniques are usually required for individuals for whom the primary cause of a learning problem is a physical handicap.

Although the majority of authorities do exclude individuals with an intellectual handicap as well, a substantial number of workers feel that many children who need additional attention are excluded by this definition and they argue for the inclusion of the mentally retarded (Johnson and Morasky, 1977). The mentally retarded are those "whose intellectual functioning is impaired across a broad spectrum of cognitive categories," resulting in subaverage general intelligence (Meier, 1976, p. 11). The learning disabled, on the other hand, are individuals with specific intellectual deficits in one or a few areas, accompanied by average or above average functioning in most cognitive areas.

Many professionals feel that individuals with a lack of learning opportunity should also be included in the learning-disabilities category, thereby increasing their chances for learning. They are frequently excluded from the definition, however, because the source of the learning problem lies in the environment rather than in a certain dysfunction within the child.

The emotionally disturbed, while generally not included in the definition, are considered to be learning disabled by some investigators since emotional

disturbance interferes with the learning process (Myers and Hammill, 1969). Its inclusion in the learning-disabilities category may be prompted by the fact that it may be difficult to determine whether the primary cause of the learning problem is the emotional disturbance or an impairment in the learning process, since the latter is frequently accompanied by the former (Silver, 1974).

By excluding these main categories -- emotionally disturbed, intellectually and physically handicapped, and culturally deprived, as well as children with low motivation -- investigators are left with a somewhat narrower definition of the central cause of the learning problem: deficit in the learning process, in the form of dyslexia, aphasia, or any other impairment in the cognitive area. Even within this type of definition, however, investigators vary greatly in the emphasis they place on different "problem areas" and the approaches they use as a result of their particular conceptualization.

Variance in the types of "problem areas" stressed is the first area of disagreement. Some definitions emphasize neurological impairment as the cause of the learning problem (Johnson and Myklebust 1967). Most investigators, however, merely assume or imply a neurological impairment, since its existence is rather difficult to show, and it is often felt that the consequences of such impairment may require remedial treatment, but the impairment itself is not the focus of treatment. Other definitions focus on motor or perceptual-motor deficits as the primary cause of the problem. For example, Kephart (1971) believes that the perceptual-motor skill of being able to match visual input with motor experience is a necessary component of the learning process. Still others stress the visual or the auditory mode as the main culprit of the learning deficiency. Finally, some investigators do not focus on any one

particular area. Valett (1969), for example, defines learning disabilities in connection with any one or more of six discriminable areas: gross motor development, sensory-motor integration, perceptual motor skills, language development, conceptual skills, and social skills.

In addition to the types of "problem areas," another important area of differentiation among the definitions is the kind of conceptualization--that is, classification of the types of concepts used to describe the nature of learning disabilities. These concepts are basically exemplified by one of three modes of classification: morphological, hierarchical (or developmental), and operational (Guilford, 1967). The first type, morphological, refers to a cross-classification of phenomena in intersecting categories where the areas of skill considered necessary for performance are not related in some type of hierarchy or sequence.

The hierarchical types of classification are developmental in nature - more complex behaviors developing out of less complex behaviors - and are most frequently used in the approaches focusing on motor development. According to these approaches, the inability to produce normal behaviors is caused by an inadequate establishment of neurological development at one of the sequential stages (Doman and Delacato, as reported in Lemer, 1976).

Finally, the operational type of approach "conceives of events in terms of interconnected series of transmissions of information." (Guilford, 1967, p. 48) The emphasis here is placed on the input, integration and production of information. Kirk's approach to the definition of learning disabilities is an example of an operational type of categorization. Three major processes are

assumed in this model: the reception of information or symbolic data, association of materials, and production of the information (Kirk and Kirk, 1971). The functioning of these processes is examined within the main sensory modes -- visual, auditory, and motor. Several other models use a similar approach. (See Slingerland and Sansara, 1970, and Malcomesius, 1967.)

The various ways of classifying learning disabilities, as represented by these approaches, can serve the purpose of identifying causes with the intent of undertaking remedial treatment or of merely identifying the nature of the disabilities.

In the present study, the definition of learning disabilities was written for the purpose of identifying the general nature of the disabilities and focused on reception, association, and production of information. An attempt was made to include the general cognitive areas related to academic underachievement, and exclude the problems of mental retardation, emotional disturbance and physical handicap. Inherent in the notion of a learning problem, coupled with emotional, physical, and intellectual integrity, is the idea of discrepancy between the state of the learning problem and the level of ability in other cognitive areas. More specifically, learning disabilities were characterized by pronounced intrapersonal differences in ability to perform a variety of verbal, quantitative, and manipulation tasks because there was an internal interference with the process of receiving information, using it in cognition processes, or communicating the results of cognition. The specific rules for identifying the learning disabled will be presented and discussed in the following section.

The Study Procedures

Ideally, under the circumstance of an ambiguous definition one should collect from a representative sample data that are descriptive of several plausible definitions, apply construct-validity analyses to these data, and from these results determine the definitions best supported empirically. Then a new set of data should be collected from a new sample to determine prevalence rates and provide remedial recommendation. The time and resources available for this study did not permit such an approach. Therefore, an *a priori* definition, based upon profile discrepancy in achievement and ability, was used to select a measurement package that was used to collect data to determine the prevalence of learning disabilities in terms of this definition. Subsequent analysis of the data that were collected was expected to provide the opportunity for refining the definition empirically, thus adding to the accumulated knowledge about learning disabilities and, if resources permitted, making it possible to reanalyze the collected protocols for revision of the incidence estimates.

The tests used to provide the data for application of the operational definition are listed under "Diagnostic Tests" in Figure I. They are tests of ability, reading, arithmetic and visual-motor integration. Data from these tests were supported as appropriate in the application of the definition by the observations listed under the heading, "Observations." In addition to the data collected for diagnosis, the group of tests labeled "Factor Marker Tests" in Figure I were administered for the purpose of providing data to evaluate the operation of the diagnostic tests in the study samples.

Figure I

Diagnostic Tests

The Wechsler Intelligence Scale for Children--Revised

Woodcock Reading Mastery Test

Keymath Diagnostic Arithmetic Test

The Bender Visual Motor Gestalt Test

Factor Marker Tests

Hidden Figures Test

Children's Embedded Figures Test

Number Comparison Test

Hidden Patterns

Swinton-Wepman Visual Orientation Test

Thurstone Flags

Observations

WISC-R

Behavioral Observations

The operational definition was expressed as a decision rule in the following sequence of decision points: (Hereafter, in discussion of the decision rule learning disabilities will be referred to as LD.)

1) A difference or discrepancy of 10 score points (11 when AC is compared with AF) within the three Witkin factors counted as 1 discrepancy toward the LD/non-LD decision. Only one discrepancy was counted from this source.

2) A difference of 15 score points between the reading and math counted as 1 discrepancy toward an LD decision.

3) A discrepancy of 10 score points between the reading score and any Witkin score counted as 1 toward an LD decision. Only one reading/Witkin discrepancy was counted.

4) A discrepancy of 15 score points between the math score and any Witkin score counted as 1 toward the decision. Only one math/ Witkin discrepancy was counted.

5) If three discrepancies were accumulated according to these rules, the case was classified as LD.

6) If two discrepancies were present among the six comparison sets, and if any one of the following conditions was also present, the case was classified as LD:

   a. A Bender score of three or more
   b. Pronounced characteristics (a score of 1) in the WISC-R observations on two or more cases
   c. Three or more occasionally observed characteristics (a score of 2) in the WISC-R observations
   d. Three or more (a score of 1) pronounced characteristics in the behavioral observations

7) If only one profile discrepancy was present, and there was a score of three or more on the Bender and the presence of two or more pronounced behavioral characteristics, the case was classified LD.

8) If no discrepancies were present but achievement T-scores[2] of 40 or less and occasional or pronounced characteristics in behavioral observations of difficulty in following oral direction, of gross or fine motor difficulty, of difficulty in oral expression, of distract-ability, and at least one score of 1 or 2 in the WISC-R performance observations were present, and the WISC-R Full Scale score was at least 33, the case was classified LD.

9) All other cases were classified as non-LD.

10) All cases classified as LD were reviewed for the presence of reading and math T-scores of 50 or greater or WISC-R Full Scale T-scores of 28 or less. These cases were reclassified as non-LD.

This decision rule was prepared to operationalize a construct of LD that presumed a breakdown in the chain of events beginning with reception and proceeding through association to production. The decision rule was not used in an attempt to identify the point of breakdown but rather to look for a constellation of symptoms from which to infer that the breakdown had occurred. For this study, relatively unsuccessful performance in the school subjects of

reading and arithmetic was a major symptom. Therefore, the decision rule included a provision for excluding youth with adequate academic performance for their age from classification as LD. Inadequate performance was not, however, considered sufficient in and of itself to classify youths as LD. The idea of discrepancy between some indicator of academic performance and some other indicator of presumably related performance was, therefore, included to aid in determining the presence or absence of LD.

In addition, evidence of two other types was considered. The types of evidence were a test of visual-motor integration and observations of both specific test taking and of general behavior characteristics that might be indicative of a breakdown in the chain of information processing. The remaining decision points through step 8 were included to reduce the likelihood of overlooking youth whose information-processing problems might be obscured by the specific task of testing and to do so in a manner that required substantial evidence before a decision was reached. The final decision point was included as a part of the consideration of academic achievement and also served to prevent the classification of youth as LD when a more appropriate diagnosis might be mental retardation.

A word about the magnitude of the discrepancies required by the rule might be appropriate at this point. In each case, the width of the discrepancy was established statistically as a first requirement and then expanded, if necessary, to represent an approximate two-year difference in performance of the norm groups as reported by the test publishers. To calculate the standard errors for statistically significant differences, the published reliability

and/or standard errors were also used. Each discrepancy was required to at least equal 1.96 times the standard error of a difference between the two tests. The discrepancies required by the decision points in the rule were each established by this process. (For more detailed discussion, see Barrows, T.S., Campbell, P.B., Slaughter, B.A., and Trainor, M.L., 1977.)

One final point on the decision rule may be informative. There were three part scores reported for each youth from the WISC-R. It was possible that one deviant score on the WISC-R and one such score on one of the achievement tests could classify a youth as LD if all possible pairs of scores were eligible for inclusion in the decision. In order to reduce the reliance of the decision on any one test, restriciton was placed on the number of discrepancies acceptable from the WISC-R alone. That restriction was applied in the first decision point of the operational definition.

A series of questions were examined in light of these data and addressed as completely as the data would allow. The questions were the following:

1) Do the selected measures operate the same in the samples identified for this study as they do in other samples, particularly the norming samples?

2) Does the theoretical factor structure that was used to provide data for applying the definition occur in both the juvenile-delinquent and public-school samples?

3) Does the selected definition work substantially the same in the public-school and juvenile-delinquent sample?

4) Is there substantial agreement concerning LD designation among alternative sets of indicators?

5) Are there alternative phenomena that plausibly can be accounting for the trait that the definition is presumably detecting?

6) How does the resulting LD prevalence estimate change in relation to changes in the operational definition?

We now turn to consideration of these questions in light of the available data.

The Study Results

1. Do the selected measures operate similarly in the sample identified for this study as they do in other samples, particularly the norming samples?

A direct comparison of means and distributions is not appropriate because the sample to whom the tests were administered was not, by design, representative of the normal population. Specifically, an attempt was made to eliminate the lower end of the continuum through screening out previously diagnosed mentally retarded youth. At the upper end, a maximum was established that eliminated youth whose achievement was average or better. Therefore, the functionalism of the test was examined in terms of the integrity of the test factors. The method used for this examination was a confirmatory factor analysis, conducted in several steps. As used in this study, a confirmatory factor analysis consists of examining the data to ascertain whether the expected factors emerge, in terms of factor structure. Briefly, a factor was considered interpretable if at least two variables had their major loadings on the factor; if the eigenvalue was equal to or greater than the average communality; and under the condition that the first requirement was met and the lowest sum of squared loadings of the rotated factors was not less than the average communality.

We began with a consideration of the total group and then broke it down into the public-school and juvenile-delinquent samples. (The specific results,

along with the appropriate tables and correlation matrices, are provided in the original report, "Psychoeducational Learning Disabled Youth, Validation Analysis," Campbell & Varvariv, Oct. 1979.)

The first step in the analysis of the workings of the tests in the total sample in contrast to the norming population concerns the WISC-R (Weschler, 1974). The number of cases was 1,105--all youth for whom test scores were available. The subtests comprising the Verbal factor are Information, Similarities, Arithmetic, Vocabulary and Comprehension. The Performance factor consisted of Picture Arrangement, Picture Completion, Block Design, Object Assembly, and Coding. Although each subtest had its major loading on the expected factor, there were other probably significant loadings for each variable on the other factor. The results observable from the available data are consistent with a supposition that the WISC-R worked similarly in the norming sample and the total sample used in this study. The public-school and juvenile-delinquent samples produced very similar results.

We could locate no independent factor analytic studies suitable for comparison for the Woodcock Reading Mastery Test and only one study, which used an educable mentally retarded group, is reported for the Keymath (Connally, et. al. 1976). However, because both tests were developed using the sample-free item characteristic curve theory of Rasch (Wright, 1967) the use of these tests in the present sample was not expected to cause problems. The procedures used by the authors of these two tests to accomplish the appropriate selection of items are detailed in the respective test manuals (Woodcock, 1973; Connally, Nachtman, and Pritchett, 1976).

Nevertheless, an examination of the means and standard deviations for possible floor or ceiling effects was appropriate. A ceiling effect would be present if substantial numbers of the youth obtained the highest scores, while a floor effect would be present if substantial numbers of youth obtained raw scores which converted to the lowest scale score or obtained a score of zero. In both tests it was found that there was ample ceiling to demonstrate ability and room for a full standard deviation below the mean before the floor was reached. Thus, the appropriateness of the use of these two tests was supported.

2. Does the theoretical factor structure that was used to provide data for applying the definition occur in both the juvenile delinquent and public school samples?

For this study, the WISC-R was interpreted using three scores derived from combining the subtests into three factors rather than the usual two factors.

These factors were studied by Witkin and his associates (Witkin, et. al., 1974), among others, and were used in this study because it was found in preliminary analysis that more information in the form of unique variance was usable in the search for discrepancies when the WISC-R was scored in this manner. (For further discussion, see Campbell and Trainor, 1978.)

In summary, we found that the differences between the expected factor structure and that found in the data from the samples tested in this study were only two--a complexity on the Coding subtest and the addition of the Picture Arrangement subtest to the Analytic Functioning factor. The remaining eight subtests loaded as expected. More importantly, there were no differences in

loading that were judged to be meaningful between the public-school and juvenile-delinquent samples. The Picture Arrangement and Coding subtests behaved approximately the same in both groups. Therefore, the working of the WISC-R in these groups was judged to be appropriate for the comparisons that were to be made.

A second analysis was designed and conducted to further evaluate the consistency of the operation of the tests in the study samples in comparison with other samples.

It was predicted that similar patterns would emerge in the population of this study. Specifically, the factor structure was predicted as follows:

Figure II

Diagnostic Test Factors	Marker Tests
Analytic Functioning Block Design Picture Completion Object Assembly	Hidden Patterns Children's Embedded Figures
Attention/Concentration Digit Span Arithmetic Coding	Number Comparisons Identical Pictures
Bender-Gestalt	Thurstone Flags Test of Memory for Visual Orientation

It was not considered necessary to examine the Verbal Comprehension marker-factor relationships because this factor had been found in more than 125 studies (Ekstrom, R.B., French, J. and Harman, H.H., 1976).

To evaluate the fit of the data to the expected structure in this analysis, a factor extension analysis was used.

For the 18 variables considered (11 WISC-R subtests, Bender, and 6 marker tests), the factor structures were substantially the same in the public-school and juvenile-delinquent samples.

In the factor extension analysis (marker tests), the comparability was somewhat less well defined. Of the 18 possible loadings (three factors times six variables) 15 were comparable by our criterion.

These results suggest that the tests produced generally comparable results in these samples as compared with norming samples, where data were available, and with the samples measured in other studies. They also suggest that the factor structure that was used in the decision rule was verified in the samples. The appropriateness of the use of these tests is, therefore, supported.

An exploratory factor analysis was also run to provide additional understanding of the measurement phenomena encountered in this study.

The matrix f variables for this analysis involved, with one exception, all those used in determining the assignment of each youth to a learning-disability or non-learning-disability category.[3] The decision criteria for factor interpretation remained the same in this analysis as those used for the confirmatory analysis reported in the preceding pages.

The Verbal Comprehension, Analytic Functioning, and Attention/Concentration factors again occurred in both public-school and juvenile-delinquent samples. The Woodcock and Keymath both loaded primarily on the Attention/Concentration factor, and the Woodcock also showed a substantial loading on the

Verbal Comprehension Factor. The observations distributed themselves between two factors with the same approximate structure observed in the total group.

The major contribution of this analysis was a further confirmation of the general comparability of the procedures in both samples, as documented by the similarity of the factor structure.

3. Does the selected definition work substantially the same in the public-school and juvenile-delinquent samples?

Differences in the operation of the definition could occur through differences in data as a result of the validity of the tests or differences in the contribution of the variables to the decision.

The decision rules that operationalized the definition were designed to allow more than one set of symptoms to be considered. Therefore, differences could be expected in the reasons for classification across the samples. We considered the contribution of each variable by assuming a linear model and computing a multiple regression of the variables on the LD/non-LD decision for the two samples -- public school and adjudicated delinquent. The magnitude of the multiple Rs was expected to be very similar, and the beta weights for each variable were also expected to be reasonably close for both samples.

The obtained multiple correlations were identical within rounding error--0.55 for the public-school sample and 0.55 for the juvenile-delinquent sample. Four variables had significant beta weights in both samples. They were the Picture Completion, Block Design, and Object Assembly subtests of the WISC-R,

and the Keymath Diagnostic Arithmetic test. Another variable having a significant beta weight for the public-school sample was the Woodcock Reading Mastery test. The Bender Motor Gestalt test also attained a significant value in the juvenile-delinquent group.

Thus, the finding from the linear model is consistent with the working of the definition. It further suggests a possible avenue for exploration of those facets of learning disability that may be related to adjudication, specifically, the consideration of the role of reading in the non-adjudicated sample versus the role of visual motor integration in the adjudicated sample.

4. Is there substantial agreement concerning LD designation among alternative sets of indicators?

A further kind of analysis that tests the construct of learning disabilities as used in this study was directed toward this question. The data for this analysis consisted of observations. The observed behaviors were as follows:

- Difficulty following oral directions
- Low frustration tolerance -- early onset of fidgeting, inattentiveness
- Guarded response style -- may be withdrawal, hostile response, evasive response
- Repeated verbalization of inability to learn
- Gross motor difficulty -- unusual awkwardness
- Fine motor difficulty -- difficulty with handling pencil or similar tasks
- Continuous rocking, tapping, drumming
- Difficulty in oral expression -- disjunctive sentences, inconsistent grammatical errors, long latency for common words
- Distractability

It was hypothesized that these behaviors would be noted more frequently among the LD cases, as defined by test discrepancies, than among non-LD cases. Also a score on the Bender Motor Gestalt test of 3 or more was expected to be noted more frequently in the LD group than in the non-LD group. Two arrays of data were specified to reflect LD symptoms other than test discrepancy results. One required at least 2 positive observations if a Bender score of 3 or greater were present (condition a) and the other at least 3 if the Bender score was 2 or less (condition b).

The relative frequency of condition a was observed to be significantly higher in the LD group than in the non-LD group ($X^2 = 11.92$, df = 1) at a probability level of 0.001. For condition b, however, the relative frequencies are not significantly different at a generally accepted level of significance ($X^2 = 2.91$, df = 1). Although there is not strong supporting evidence of the adequacy of the definition from these data, the results are consistent with such an assumption in the case of condition a--the Bender/observation combination.

The failure of the observations alone to differentiate between the two groups can be reasonably considered a weakness of these variables rather than a problem of the test-based definition. The observations did not have significant beta weights in the alternative linear model discussed earlier.

Another possible explanation may be the presence of an observer effect. Since a second observation of each youth was not available in these data, it is not possible to compute an observer reliability index. In the final section of this report, a suggested design will be presented that should provide better answers to these questions.

In summary, it is our judgment that the results of this analysis are consistent with the definition as operationalized, although the data from this study should be cross validated with other samples and, preferably, augmented with additional observations to further verify the adequacy of the definition.

5. Are there alternative phenomena that plausibly can be accounting for the trait that the definition is presumably detecting?

Some special problem areas need to be taken into account in order to deal with rival explanations for classifying a child as learning disabled. More specifically, although a youth was assumed to be classified as learning disabled due to some deficiency in the learning process that is not obvious, there remained a possibility that the youth exhibited those symptoms because of low motivation, lack of learning opportunity, or emotional disturbance.

The available data did not provide a way to differentiate between lack of opportunity and low motivation. Indeed, low motivation may be a consequence of lack of opportunity. However, neither condition is synonomous with learning disability, and it was not necessary to disentangle them for the purpose of considering the validity of the decision rule in classifying the youth as LD or not. All that was necessary was to determine whether either or both conditions were plausible alternative explanations for substantial numbers of classifications.

In order to test the hypotheses that children were classified as LD because of low motivation or lack of learning opportunity, two analyses were designed. The analyses were to reveal the percentage of children classified as LD who also had the data patterns expected to be associated with low motivation or lack of learning opportunity.

The first analysis focused both on lack of learning opportunity and on general low motivation. If children had a lack of learning opportunity it was considered that they would perform poorly both in reading and in arithmetic (low, flat profile). A low, flat profile may also be indicative of low motivation. Furthermore, the WISC-R score should be fairly high to assure the child's ability to perform if given the opportunity or having the motivation to learn in the school situation. A low score in the Bender was taken to indicate that there was no perceptual problem evident, while the absence of observed difficulties in the motor visual, hearing, or language area suggested that there was no supporting evidence for an LD classification. Thus, the decision rule was set as follows:

1) T = 47 or less on Reading and Math;

2) Bender of 2 or less;

3) WISC-R full scale T = 40 or more;

4) Score of 3 (not observed) on difficulty in following oral directions, gross motor difficulty, fine motor difficulty, difficulty in oral expressions, vision problems and hearing problems.

The T-score for achievement was set at 47 because that is the scale value below which our educationally and statistically significant discrepancy in achievement could not occur.[4] It is also below the expected midpoint of performance for the age and grade of the youth. The Bender score also reflects the cutting point used in the decision rule. The WISC-R score was set at the point determined by adding the average width of the error bands for reading and arithmetic to the highest WISC-R score that would have resulted in a classification of mental retardation. This analysis was applied to the total sample. The decision rule classified 409 youth as LD in the total sample. Of

these 409 youth, only 35 had data patterns that fit the criteria for the effects of low motivation and/or lack of opportunity which could have resulted in classification as LD.

The second analysis was concerned primarily with selective low motivation. Poor performance in only one subject may also be indicative of low motivation. To assure significant discrepancy between the two subjects, a 15-point difference was required, with one of the subjects being very low in achievement. There were two reasons for these requirements. The 15-point difference was required because it was consistent with the established band for educational and statistical significance. The score in one achievement area was required to be significantly lower than a minimum WISC-R score to assure the requisite ability to perform.

These criteria are somewhat conservative in identifying the possible effects of low motivation because they admit only those youth whose best achievement is at or below the midpoint. It is, therefore, possible that the occurrence of this data pattern might be more frequent if higher achievement were included. The problem of such an analysis is that it fails to differentiate between selective low motivation and genuine LD discrepancies. Pending a redefinition of selective motivation and the design and execution of the proper analysis, we present herein the results of the conservative analysis.

Of the 409 cases who were classified as LD in the total sample, only 4 met the conservative criteria of selective low motivation. This finding provides further support for the assumption that selective low motivation was not a plausible explanation for classification as LD by the decision rule used in this study.

Emotional disturbance was the third alternative that could be expected to interfere with learning. It could operate through inability to concentrate, through inability to relate to the teacher, or through behavior directed away from the learning task, either by active avoidance or by preoccupation outside the task. As indicated previously, prior to testing, the records of suspected cases were clinically evaluated by a certified diagnostician and excluded from the sample if emotional disturbance appeared to be primary or if severity was sufficient to prevent adequate testing. We were unable to obtain additional evidence of this particular phenomenon among the LD cases with the data at hand. Therefore, our rejection of this hypothesis must rest upon the adequacy of the clinical judgment that was made by the certified diagnostic supervisor at each site.

6. How does the resulting LD prevalence estimate change in relation to changes in the operational definition?

Identification of the learning disabled depends, to a degree, on the cut-off points of the ability and achievement measures. In order to study the differences in prevalence, several analyses were designed with ability and achievement scores set at different cut-off points.

The total sample used for the analyses consisted of 12- to 15-year-olds, including youths who were only interviewed (n = 1319). The data are presented in Table I. The first prevalence analysis revealed the percentage classified LD according to the original decision rules, with ability level of 28 (T score). The LD prevalence is 19.1 percent in the public-school sample (n = 958) and 38.2 percent in the juvenile-delinquent sample (n = 361). Thus, significantly more LDs (at 0.001 level of significance) are found in the juvenile-delinquent than in the public-school sample.

The second prevalence analysis was designed for examining the difference in the percentage of LD youth when the LD category excludes children with an ability level of 37 or less. This cut-off point was chosen arbitrarily because an IQ of 80 (T-score 37) is reasonably above the mentally retarded range as previously defined and is within the commonly accepted borderline IQ range of 70-84 (Meier, 1976). The remainder of the decision rule was applied as previously.

Table I

LD Prevalence Rates Reflecting
Variations of the Decison Rules

	Analysis 1	Analysis 2	Analysis 3	Analysis 4
Public School	19.1	17.5	22.2	20.6
Juvenile Delinquent	38.2	27.7	39.0	28.5

1. Original decision rules
2. Exclusion of cases with ability T-score less than or equal to 37
3. Elimination of achievement level restriction
4. Combination of rules 2 and 3

In the second prevalence analysis, results showed that the percentages of LD cases were 17.5 in the public-school sample and 27.7 in the juvenile-delinquent sample. While the difference in the LD prevalence was still significant (at 0.01 level), it was less significant than in the previous analysis (19.1 percent vs. 38.2 percent) because more of the juvenile delinquents than of the public-school youth were excluded from the LD category by the new rule (i.e., a higher percentage of the learning-disabled/juvenile-delinquent youth than learning-disabled/public-school youth had an ability score of 37 or below).

In order to pursue the question of the interaction of ability and learning disability and its effect on juvenile delinquency, we focused on LD youth alone in an additional analysis.

Ability level and learning disability were treated as the independent variables, while juvenile delinquency was examined as the dependent variable. (See Table II.)

Table II

Effect of Ability on Adjudication Status Among Learning Disabled

	Ability above 37	Ability of 37 or below	Total
Public School	168	15	183
Juvenile Delinquent	100	38	138
	268	53	321

Overall significance was evaluated by a chi-square test, which produced a result of 6.64. A post-hoc comparison between the learning-disability/juvenile-deliquent groups of high and low ability levels was done by establishing a standard error of difference between proportions, which equaled 0.178, significant at the 0.01 level. Results indicated that significantly more cases of LD youth of the low ability level are adjudicated than of the high ability level (7 out of 10 and 1 out of 3, respectively).

While this finding suggests that ability level has a significant effect on juvenile delinquency, results of the study, as a whole, support the notion that adjudication is, to a certain extent, a function of learning disability. Thus, the findings imply that an interaction exists between ability level and

learning disability in its effect on adjudication. It seems important to verify these findings through further research, and if they are verified, to determine the point at which the effect of learning disability becomes primary.

The third prevalence analysis focused on achievement rather than ability. It was based on the notion that some children may have developed better coping styles in school subjects even though symptoms of related disabilities and discrepancies would classify them as LD. The decision rule, in this case, eliminated the achievement restriction by permitting inclusion in the LD category of those with reading and arithmetic T-scores greater than or equal to 50 when the remaining original rules were applied. Results showed that the percentage of LD cases was 39.0 in the juvenile-delinquent sample--higher by less than one percentage point than the original analysis (38.2 percent), and 22.2 in the public-school sample--higher by 3.1 percentage points than the original analysis (19.1 percent). Thus, results indicated that the increase in LD prevalence was greater among the public-school youth than among the juvenile-delinquent youth.

In the final analysis the achievement level restriction was eliminated, as in the previous analysis, and the minimum ability level was raised to exclude those with an ability score of 37 or less. The same reasoning followed for this analysis as for the previous one. The percentage of LD cases in the juvenile-delinquent sample was found to be 28.5--higher by 0.8 percentage points than in the second analysis which used the same ability cut-off (27.7 percent), and in the public-school sample the percentage was 20.7--higher by 3.2 percentage points than in the second analysis (17.5 percent).

The findings of the last two analyses support the notion that some youth do develop coping styles in school subjects even though other symptoms would classify them as LD. Moreover, the findings suggest that the youth with symptoms of LD but no court records show more evidence of being able to cope in school than those whose cases had been adjudicated. The implication is that if coping styles were developed, adjudication might be avoided. It may be useful to explore this notion in further research.

Summary

The overall conclusions drawn from these analyses may be summarized in brief discussions of three principal points: the validity of the tests for the use to which they were applied, the tenability of the definition of learning disabilities, and the prevalence of learning disabilities, as defined, in the public-school and adjudicated delinquent samples.

The data generally supported the selection of the tests included in the measurement package. The factor structures were similar to those presented for the norms groups where those were available and for other samples in which the same tests were used. Adding to the relevance of this finding was the high similarity of the factor structure within the two samples that were tested in this study. Although there was not a known sample other than these that utilized the same tests in a battery, the assumption that the tests functioned consistently as a battery was supported by the exploratory factor analysis, which included all of the data collection devices or procedures except the WISC-R observations. This factor analysis revealed a highly similar factor structure for all parts of the battery in both the public-school and the

adjudicated delinquent samples. It is our conclusion that the tests considered individually and as a battery have demonstrated acceptable validity for the purpose of providing data for the application of the decision rule used in this study.

The definition of learning disabilities was consistent in its results in both the public-school and juvenile-delinquent samples and was therefore moderately supported by the available data. Some competing hypotheses--specifically low motivation and lack of learning opportunity--did not appear highly plausible as explanations of the classifications by the definition. The data did not, however, permit conclusive exclusion of these hypotheses because their effects could not be unambiguously identified within this data set. As a conservative conclusion, the data tend to support the definition and do not specifically discredit it at any point. Rather, they do not strongly confirm it. It is our judgment that the definition is useful and workable in an interim sense, pending the development of a definition based upon unambiguous indicators of learning disabilities.

The final prevalence estimate for these samples of public-school youth and delinquent 12- to 15-year-old boys whose cases have been adjudicated, as reported earlier in this paper, are 19.1 percent and 38.2 percent, respectively. These percentages changed somewhat as the rule was changed to take into account differing levels of achievement and ability.

There appeared to be a decrease in the prevalence of learning disability within the adjudicated sample when the ability level required to classify as learning disabled was increased. This decrease in prevalence also appeared in the public-school sample, but to an apparently negligible degree.

When the restriction on achievement was removed, moderate increases in prevalence appeared in both groups, but were somewhat greater for the public school group.

When the rule was modified to require a higher ability level than specified originally and the restriction on achievement level was removed, the change in prevalence for the public-school sample was probably negligible (1.5 percentage points). For the adjudicated sample, the change in prevalence was approximately the same as that produced by modification of the ability-level requirement alone.

The effect of level of ability on the classification appeared to be the most important one and should be subjected to further examination.

Suggested Additional Research and Further Analyses

In addition to the obvious desirability of repeating the present study with a new sample of similar constitution to assess the stability of the obtained results, several other lines of inquiry are suggested by these results.

The most important suggested line of inquiry, in our opinion, is a study devoted to a rigorous definition of the complex phenomena that are labelled "learning disabilities." Such a study would probably best proceed from a case-study approach. It would require a variety of methods to identify the characteristics of the individual that seem to prevent useful learning of the complex academic and social skills that are apparently necessary for functioning without running seriously afoul of codified societal norms. In the

pure form, this analysis would require that the problem of identification be approached by alternative identifications of the same construct, using alternative measurements, and that alternative explanations of the observed educational problems be tested simultaneously by collecting data that were expected to identify the alternatives.

The definition based on discrepancies, as used in the present study, focuses on the outcomes or results of learning disabilities rather than on their source. Because specific outcomes may have a variety of alternative sources, a discrepancy definition is not likely to be adequately unambiguous. A better definition should include assessment of receptivity of signals from the environment, assessment of the processing of these signals, and assessment of the adequacy of responses or productions as a result of signal receptivity and processing. Our review of the literature presented earlier in this paper did not reveal satisfactory solutions to these assessment problems.

Several useful analyses could also be conducted with the present data. A cluster analysis might be particularly useful in identifying clusters of youth with similar traits from which the nature of interaction with the courts, if any, could be considered.

Another suggested analysis involves the recalculation of the prevalence estimates following the preparation of a different computer program for the application of the rule. As designed, the rule reclassified all cases removed from the LD classification by step ten--the ability and achievement restrictions--as non-learning disabled. These reclassifications were logically correct, but resulted in the inclusion in the non-LD portion of the sample

certain cases that would have been eliminated had adequate testing data been available in the youth's record at the time of review. On the other hand, those cases that were reclassified because of relatively high achievement should properly remain as non-LD, both from the standpoint of the definition and from the standpoint of the records review process.

In addition to these considerations, a reevaluation of the operational definition in terms of the role of ability is suggested. The rule, as written, accepted discrepancies between ability and achievement in which the ability score was lower than the achievement score. While a case can be made for the use of such a symptom as evidence of learning disability, it is not a reflection of the popular conception of the phenomenon as evidenced, for example, in the proposed federal definition (Federal Register, 1976). Therefore, a restricted definition that accepted only those discrepancies which followed a high-ability-low-achievement pattern would be of interest.

Finally, the apparent interactions among ability, learning disability, and adjudication at the low-ability level suggests that an analysis should be designed to determine at what point the observed relationship becomes nonsignificant, if it does.

These suggestions for additional analysis are by no means exhaustive, but appear to be useful and promising lines of inquiry.

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Footnotes

[1] The project was subsequently transferred to the National Center for State Courts.

[2] T-scores are derived standard scores with a mean of 50 and a standard deviation of 10. In this study the scores were converted directly from deviation IQs in the case of the WISC-R and from percentiles provided by the publishers in the case of the Woodcock Reading Mastery Test and the Keymath Diagnostic Arithmetic Test.

[3] The exception was a set of four observations specific to the WISC-R, which were also strongly reflected in the scores for the WISC-R, and were, therefore, considered redundant.

[4] A discrepancy could occur between ability and achievement for achievement scores below this point, but not between achievement scores.