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SPECIAL EDUCATION OUTCOMES FOR PREMATURE AND/OR LOW BIRTH WEIGHT INFANTS, AND THE EFFECTS OF PREMATURITY, INTRA-UTERINE GROWTH RETARDATION, AND SOCIOECONOMIC STATUS ON LEARNING DISABILITIES

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ABSTRACT

SPECIAL EDUCATION OUTCOMES FOR PREMATURE AND/OR LOW BIRTH WEIGHT INFANTS, AND THE EFFECTS OF PREMATURITY, INTRA-UTERINE GROWTH RETARDATION, AND SOCIOECONOMIC STATUS ON LEARNING DISABILITIES

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Long-term special education outcomes were investigated for three distinct groups of premature and/or low birth weight infants, premature appropriate for gestational age (PTAGA), preterm small for gestational age (PTSGA), and full-term small for gestational age (FTSGA), then compared with local population rates. A total of 42 PTAGA, 26 PTSGA, and 14 FTSGA infants were followed until they were approximately 8 to 14 years of age. Intelligence, academic achievement, grade retentions, educational services, and the chronology of program decisions were described and compared for each group, and the impact of gender and socioeconomic status (SES). Group comparisons involved matching PTSGA and PTAGA children on the basis of gestational age, and FTSGA and PTAGA children on birthweight. Matches also involved gender, SES, and birth date.

The second part of the study more closely assessed learning disabilities for these groups using standard score discrepancy and regression analysis discrepancy models. IEPC identified learning disabled (LD) subjects were compared with matched local LD students with normal neonatal backgrounds to locate distinct patterns of learning disabilities. The strength of relationship for ability/achievement discrepancies with socioeconomic and neonatal variables was addressed using multiple regression analysis.

The at-risk group's total average of handicaps exceeded local rates by 8% to 17.6%. Learning disabilities were 1.87 more likely, and severe multiple impairments were 29 to 54 times more evident for the three groups. Upper-middle SES subjects had a larger proportion of the handicaps, although these findings were based on an unrepresentative population. Grade retention rates ranged from 28.6% to 50% for the three groups. Lower SES males were retained more than higher SES subjects.

No significant differences in IQ or academic achievement were detected between PTSGA/PTAGA or FTSGA/PTAGA matched groups. Lower SES subjects had significantly lower achievement than higher SES matches in four of eight areas. Comparing at-risk IEPC identified LD and local LD children, one significant factor was identified, perceptual organization.

For IEPC identified LD subjects, a small, yet significant relationship was evident regarding lower maternal education and smaller family size only. A significant small neonatal and gender/LD relationship was found with regression analysis discrepancy and standard score discrepancy methods.

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LIST OF ABBREVIATIONS

AGA	Appropriate for Gestational Age
BWT	Birth Weight
DAC	Developmental Assessment Clinic
EISD	Eaton Intermediate School District
EI	Emotionally Impaired
EMI	Educable Mentally Impaired
FTSGA	Full-Term Small for Gestational Age
FT	Full-Term
GA	Gestational Age
HI	Hearing Impaired
ICU	Intensive Care Unit
IEPC	Individual Educational Planning Committee
IUGR	Intrauterine Growth Retardation
IQ	Intelligence Quotient
POHI	Physically or Otherwise Health Impaired
PTAGA	Pre-Term Appropriate for Gestational Age
PTSGA	Pre-Term Small for Gestational Age
PT	Pre-Term
RDS	Respiratory Distress Syndrome
RNICU	Regional Neonatal Intensive Care Unit
SAT	Stanford Achievement Test
SES	Socioeconomic Status
SGA	Small for Gestational Age
SLI	Speech and Language Impaired
SXI	Severely Multiply Impaired
WISC	Wechsler Intelligence Scale for Children
WISC-R	Wechsler Intelligence Scale for Children-Revised
WRAT	Wide Range Achievement Test
WRAT-R	Wide Range Achievement Test-Revised

CHAPTER I

INTRODUCTION

Historically, most premature (gestational age of 37 weeks or less), low birth weight (less than 2500 grams) infants died in the early 1900s. Those that survived were relatively free from handicapping conditions (McCormick, 1985; Stewart, Reynolds, & Lipscomb, 1981). This pattern changed during the 1950s when mortality rates decreased and the incidence of handicaps increased (Hack, Fanaroff, & Merkatz, 1979; Stewart et al., 1981). However, from the 1960s until the present, both mortality and major handicap rates have decreased (Hack et al., 1979; McCormick, 1985; Stewart et al., 1981). For infants weighing 1500 grams and less, there is a 25% to 45% mortality rate, and an 8% to 19% incidence of moderate to severe handicap (cerebral palsy, mental retardation, profound hearing loss, visual impairment, and hydrocephalus) (McCormick, 1989; Shapiro, McCormick, Starfield, & Crawley, 1983; Stewart et al., 1981). This compares to a 1% mortality rate for all live births in the United States (U.N. Children's Fund, 1985) and a 2% to 3% disability rate (Healy, 1983). However, questions remain regarding the prevalence and etiology of less severe handicaps, particularly specific learning disabilities (LD), for this at-risk population. This is an important issue as some authors have predicted that the numbers of children with less severe types of handicaps will increase with the decrease in mortality and major handicap rates (Fitzhardinge, 1976; McCormick, 1989).

Consequently, it is important for researchers and practitioners from the fields of medicine, psychology, and education to determine whether premature, low birth weight infants indeed have a greater prevalence of handicaps, particularly for less severe conditions (specific learning disabilities). Likewise, it is important to identify specific risk factors in the premature, low birth weight population, and to note their relative impact on special education outcomes. If it can be demonstrated that particular factors or types of premature, low birth weight infants remain at greater risk for specific handicaps, then physicians, school psychologists, and special educators will need to more closely monitor these children's progress through their school years. And should it be found that different groups have higher prevalence rates of the so-called less severe handicaps, it could be useful to ascertain whether premature, low birth weight infants represent or display a distinct pattern or type of disability. With these considerations in mind, it will be important to clarify how prematurity, low birth weight, intrauterine growth retardation, socioeconomic status, and gender relate to learning disabilities.

As some researchers have proposed that children who are born too early or too little have suffered central nervous system insult and therefore are at-risk for developing later learning disabilities, it is important to accurately assess and follow homogeneous groups of premature and/or low birth weight infants into their school years. Some investigators have found some early developmental delays to be transient and that between 65% and 75% of these children attend normal school programs (Drillien, Thomson, & Burgoyne, 1980; Kitchen et al., 1980; Kitchen et al., 1987; Lefebvre, Bard, Veilleux, & Martel, 1988). Other researchers have found, however, that between 24% and 64% of this at-risk population receive some form of special education service (Lefebvre et al., 1988; Nickel, Bennett, & Lamson, 1982; Sell, Gaines, Gluckman, & Williams, 1985). Furthermore, it has been shown that environmental factors progressively impact cognitive and academic outcomes for this at-risk population from birth onward. Consequently, it will be important to obtain a better understanding of these relationships as they relate to long-term outcomes.

The goals of this research were as follows:

1. To describe the incidence of identified special education handicaps for three specific groups of premature and/or low birth weight infants at school age (the preterm appropriate for gestational age [PTAGA], the full-term small for gestational age [FTSGA], and the premature small for gestational age [PTSGA]). And to compare these results with the local population rates on the basis of gender, socioeconomic status (SES), and age at the time of the referral.

2. To describe grade retentions, remedial education programs, special education programs and services, and the chronology of placement decisions for

the three at-risk groups of premature and/or low birth weight children. And to compare these results with local population results.

3. To determine the prevalence of psychometrically identified learning disabilities using an 18, 20, and 24 standard score point ability/achievement discrepancy and regression analysis (2, 5, and 6.5 percentile cutting scores). Controlling for gender and socioeconomic status, to compare preterm AGA and preterm SGA infants with matched gestational ages, and preterm AGA infants with full-term SGA children with matched birth weights. And to describe the severity of the ability/achievement discrepancies, intelligence test results, and academic achievement for these groups.

4. To determine the prevalence of psychometrically identified learning disabilities (using the previous goal's statistical procedures) for high and low SES groups of preterm AGA, PTSGA, and FTSGA infants matched on the basis of gender, SES, and age. And to describe the severity of the ability/achievement discrepancies, intelligence test results, and academic achievement for these groups.

5. To investigate whether at-risk learning disabled (LD) infants display a distinct pattern of learning disabilities in comparison with the general LD population. And to describe and compare the severity of the ability/achievement discrepancies, intelligence test results, and academic achievement for these groups.

6. To assess the strength of relationship for psychometrically and Individual Educational Planning Committee (IEPC) identified learning disabilities with race, gender, family marital status, maternal and paternal education, maternal and paternal occupation, birth order, family size, low birth weight, prematurity, intrauterine growth retardation (IUGR), episodes of otitis media, birth asphyxia, length of Intensive Care Unit (ICU) hospitalization, need for and time on ventilator, grade of intracranial hemorrhage, and seizures.

CHAPTER II

REVIEW OF LITERATURE

This review of literature will analyze and integrate two broad areas of research. The first area of investigation involves long-term educational outcome studies for premature and/or low birth weight infants. This review starts by examining the critical identifying characteristics of this at-risk population, progresses to intellectual and academic outcomes, and then describes socioeconomic and gender-related influences. Finally, it will describe the research on this at-risk group's involvement in special education programs, grade retentions, and other educational interventions.

The second area of investigation focuses on research related to the relationship of learning disabilities with prematurity and/or low birth weight. Beginning with classification and definition issues of learning disabilities, this review looks at etiological questions by first exploring large-scale epidemiological studies, then relating learning disabilities to SES, gender, and perinatal factors.

Prematurity and Low Birth Weight

Studying the educational handicaps of premature, low birth weight infants has proven troublesome because of the group's heterogeneous nature. For example, classifying infants by gestational age and birth weight involves three specific patterns and, often, multiple etiologies (Blackman, 1984; Korones, 1986; Behrman, Vaughan, & Nelson, 1983). These are: (a) premature infants who are appropriately grown for their gestational age (AGA), (b) small for gestational age (SGA) infants who have slow intrauterine growth rates and delivered at or later than 37 weeks, and (c) the small for date or SGA, premature infants with a retarded rate of intrauterine growth and early delivery. SGA or intrauterine growth retardation (IUGR) has been defined by neonatalogists as birth weight/ gestational age ratio falling below the 10th percentile, or scoring 2 or more standard deviations below the mean on population-based intrauterine growth curves. The more severe cut-off has sometimes been used as a means of adjusting for ethnic or nationality differences, or denoting extremes of the SGA population (Hoffman & Bakketeig, 1984). Gestational age typically is determined by counting the time since the first day of the last menstrual period, or using a postnatal system developed by Dubowitz and his co-workers (Dubowitz, Dubowitz, & Goldberg, 1970). Intrauterine growth retardation occurs in approximately one-third of all low birth weight infants (Behrman et al., 1983; Korones, 1986).

According to Behrman et al. (1983),

> premature AGA births are associated with conditions where there is an inability of the uterus to retain the fetus, interference with the course of the pregnancy, premature separation of the placenta, or a stimulus to cause uterine contractions prior to term. Intrauterine growth retardation is associated with conditions that interfere with the circulation and efficiency

> of the placenta, with the development or growth of the fetus, or with the general health and health and nutrition of the mother. (p. 442)

Furthermore, lower levels of SES positively correlate with both prematurity and low birth weight (Behrman et al., 1983; Korones, 1986). Other attempts at classifying premature, low birth weight infants included differentiating intrauterine growth patterns (symmetrical versus asymmetrical physical proportions), etiology (genetics, congenital infections, maternal conditions, maternal ingestions, and placental abnormalities), congenital malformations, and perinatal complications (perinatal asphyxia, hypoglycemia, and polycythemia) according to Allen (1984), Behrman et al. (1983), and Korones (1986). Consequently, it must be recognized that premature, low birth weight infants represent a common outcome of a heterogeneous population that researchers are attempting to classify in order to more clearly define risk parameters for specific groups of children.

Children who are born too early are considered to be at special risk because of their susceptibility to cerebral hemorrhage (Hunt, 1986). And children who are born too little are thought to be at-risk because of the evidence of fetal malnutrition (Teberg, Walther, & Pena, 1988). Regarding the association between prematurity and/or low birth weight and less severe handicaps, Fitzhardinge (1976) proposed that these infants may have suffered some degree of central nervous system insult. If a major handicap has not occurred, it is assumed that minor dysfunctions are inevitable. For these children, it is postulated that neurological sequelae will be subtle and possibly not evidenced until faced with school-aged tasks requiring higher levels of central nervous system functioning. However, as prospective studies have shown (and will be discussed shortly), there is a wide variance of outcomes. Environmental factors as well as brain plasticity have powerful modulating effects on severe neonatal problems (Hunt, 1986). Sameroff and Chandler (1975), in their review of prematurity, found little evidence to support the proposition that being born too early alone produced poor developmental outcomes.

Intellectual Outcomes

In spite of these definitional and classification issues, much has been learned about the cognitive abilities of premature, low birth weight infants. According to reviews studying premature, low birth weight infants (Caputo & Mandell, 1970; Cohen, 1986; Kopp, 1983; Kopp & Parmelee, 1979) and studies controlling for the effects of SES (Drillien et al., 1980; Dunn, 1986; Klein, Hack, & Breslau, 1989; Lindahl, Michelsson, Helenius, & Parre, 1988; Lloyd, Wheldall, & Perks, 1988; Noble-Jamieson, Lukeman, Silverman, & Davies, 1982; Rubin, Rosenblatt, & Balow, 1973; Wiener, 1968), intelligence for this undifferentiated group of children is significantly lower than that for full-term, normal birth weight infants by 7.4 standard score points on average (Table 1), generally using the Wechsler Intelligence Scale for Children (WISC). However, the average IQ for the low birth weight group is still within the average range for the vast majority of studies. It was also found that premature and/or low birth weight infants from lower socioeconomic groups, on average, score 14 points lower than groups of infants from middle- to upper-class groups at 4 to 10 years of age (Drillien et al., *3

Table 1: Intellectual outcomes for composite groups of pre-term and/or low birth weight infants versus full-term, normal infants.

Study	Age	Type	IQ			FT/AGA IQ		
Wiener (1969)	12-13	White <2000g	V96	P92	FS97	V102	P106	FS105
		Afr. Amer.	84	86	83	90	92	90
		White 2000-2500g	98	101	99			
		Afr. Amer	86	88	85			
Rubin et al. (1973)	7	PT <2500g	M97			M104		
		NS SGA	F98			F103		
Drillien et al. (1980)	6.7	<2000g SES: 1	V110	P109	FS110	V119	P118	FS120
		PT or 2	102	108	105	104	113	109
		SGA 3	98	101	98	102	107	103
		4	91	95	91	94	97	94
Noble-Jamieson et al. (1982)	9.1	PT <1500g NS SGA, GA=31 wks BWT=1400g	V98	P99	FS98	V107	P107	FS109
Dunn (1986)	6.5	PT/AGA & SES: 1-3	V105			V114		
		SGA (PT & FT) 4	98			110		
		PT/AGA & SGA) 5	92			105		
			97	P100	FS98	109	P109	FS109
Lloyd et al. (1988)	7	PT <1500g, NS SGA	M91					
		GA=32 wks	F94					
		BWT=1320g	Total 93			100		

Table 1: Continued.

Study	Age	Type	IQ			FT/AGA IQ		
Lindahl et al. (1988)	8-9	LBW, GA=37wks BWT=2932g	V116	P113	FS114	V118	P119	FS120
Klein et al. (1989)	9	PT <1500g, no neurol. handicap	V92	P93	FS92	V98	P99	FS98

Note: Average 7.4 point IQ disadvantage for PT/LBW/SGA infants.

Key:
SGA = small for gestational age
AGA = appropriate for gestational age
GA = gestational age mean
BWT = birth weight mean
LBW = low birth weight
SES = socioeconomic status
IQ = intelligence quotient mean
V = verbal IQ mean
P = performance IQ mean
NS = not specified
PT = pre-term
FT = full term
UC = upper class
LC = lower class
M = male
F = female
FS = full-scale IQ

1980; Dunn, 1986; Eaves, Nuttall, Klonoff, & Dunn, 1970; Escalona, 1982; Francis-Williams & Davies, 1974; Wallace, Escalona, McCarton-Daum, & Vaughan, 1982). Furthermore, there is evidence that the effects of an adverse socioeconomic environment progressively impact IQ from 2 years onwards, even though IQ scores for infants of different social classes are similar at younger ages (Drillien, 1964; Drillien et al., 1980; Kalmar & Boronkai, 1991; Wallace et al., 1982). However, it is not known how environmental factors specifically cause these outcomes.

The full-term SGA infant (Table 2) mean IQ is 5.6 points lower, on average, than full-term, normal birth weight comparisons, and 9.6 points above (Table 5) pre-term SGA infants (Drillien, 1970; Fitzhardinge & Steven, 1972; Harvey, Prince, Burton, Parkinson, & Campbell, 1982; Low et al., 1982; Neligan, Kolvin, Scott, & Garside, 1976). Although there are few studies comparing pre-term SGA infants with normal birth weight groups, it does appear that their mean IQ is significantly lower. In studies (Table 3) controlling for socioeconomic factors, there is an average IQ disadvantage of 12.5 points for these small for gestational age children (Drillien, 1970; Robertson, Etches, & Kyle, 1990). Likewise, pre-term infants also score significantly lower than full-term AGA peers. In SES-controlled studies of pre-term children's long-term intellectual outcomes (Table 4), their scores are 11.5 IQ points, on average, lower than normal groups of children (Drillien, 1970; Dunn, 1986; Robertson et al., 1990). Furthermore, there is

Table 2: Intellectual outcomes for full-term SGA versus full-term AGA.

Study	Age	Type	FT/SGA IQ	FT/AGA IQ
Drillien (1970)	10-12	BWT=2246g SES:	UC 111 LC 93	UC 111 LC 102
Fitzhardinge & Steven (1972)	5-11	NS BWT	M 95 F 101	M 106 F 102
Neligan et al. (1976)	5 6	5%-10%, BWT=2701g <5% BWT=2397g <5%-10% group SES: UC MC LC	V95 | P94 | FS94 94 | 90 | 91 105 94 85	V101 | P98 | FS100 116 98 99
Low et al. (1982)	5-6	NS BWT M F	106 105	103 106
Harvey et al. (1982)	5	NS BWT, retarded head growth Before 26 wks After 26 wks	103 113	115

Note: Average 5.6 point IQ disadvantage for the FT/SGA infants.

Table 3: Intellectual outcomes for pre-term SGA versus full-term AGA.

Study	Age	Type	PT/SGA IQ	FT/AGA IQ
Drillien (1970)	10-12	GA=35 wks SES: UC BWT=1581g LC	97 89	111 102
Robertson et al. (1990)	8	GA=34 wks	102	112

Note: Average 12.5 point IQ disadvantage for PT/SGA.

Table 4: Intellectual outcomes for pre-term SGA versus full-term AGA.

Study	Age	Type	PT/SGA IQ	FT/AGA IQ
Drillien (1970)	10-12	GA=33 wks SES: UC	97	111
		BWT=1940g LC	89	102
Dunn (1986)	6.5	<37 wks SES: 1-3	105	114
		<2041g 4	100	110
		5	91	105
Robertson et al. (1990)	8	GA=29 wks BWT=1252g	102	112
		GA=33 wks BWT=1818g	101	112

Note: Average 11.8 point IQ disadvantage for the PT/AGA.

Table 5: Intellectual outcomes for pre-term SGA versus full-term SGA.

Study	Age	Type	PT/SGA IQ	FT/AGA IQ
Drillien (1970)	10-12	PT/SGA GA=35wks BWT=1581g SES: UC	97	111
		FT/SGA BWT=2246g SES: LC	89	93

Note: Average 9.6 point IQ disadvantage for PT/AGA.

evidence that mean IQ scores progressively decrease with lower birth weights (Dunn, 1986).

Aside from Pena, Teberg, and Finello (1987) and Robertson et al. (1990), no accurate comparisons have been made between premature SGA and premature AGA infants. Whereas there is an average 6.4 pre-term AGA advantage in studies (Table 6) controlling for SES effects (Drillien, 1970; Fitzhardinge, Kalman, Ashby, & Pape, 1978; Francis-Williams & Davies, 1974; Pena et al., 1987; Robertson et al., 1990; Vohr & Hack, 1982), most researchers have not matched these groups on the basis of gestational age. To ignore matching on this factor results in comparing two heterogeneous groups with different levels of physical and neurological maturation that have different sets of perinatal and neonatal complications. Thus, to match groups on gestational age would allow investigators to accurately assess the outcomes of intrauterine growth retardation aside from maturational effects. Only Pena et al. (1987) and Robertson et al. (1990) have used this matching strategy. Interestingly, their results are contradictory. Pena et al. (1987) noted significant IQ differences at 40 weeks in favor of the PTAGA child, whereas Robertson et al. (1990) found no differences in intelligence scores at 8 years of age. Differences between these investigators' results may relate to the subjects' ages at the time of evaluation, group SES differences, or yet-undetermined variables.

In general, research on premature and/or low birth weight infants' cognitive abilities has typically noted only group means and differences, rather than

Table 6: Intellectual outcomes for pre-term SGA versus pre-term AGA.

Study	Age	Type	PT/SGA IQ	PT/AGA IQ
Drillien (1970)	10-12	PT/SGA GA=35 wks SES: UC BWT=1581g LC PT/AGA GA=33 wks BWT=1940g	97 89	97 96
Francis-Williams & Davis (1974)	4-12	PT/SGA GA=34 wks BWT=1310g PT/AGA GA=30 wks BWT=1277g	92	99
Fitzhardinge et al. (1978)	2	PT/SGA & PT/AGA GA<33 wks BWT<1500g	86	97
Vohr & Hack (1982)	1	PT/SGA GA=33 wks BWT=1190g PT/AGA GA=29 wks BWT=1221g	77 (MDI)	90 (MDI)
Pena et al. (1987)	40 wks	PT/SGA GA=31 wks BWT=1006g PT/AGA GA=31 wks BWT=1294g	PT/SGA MDI less than PT/AGA $p < .001$ difference	
Robertson et al. (1990)	8	PT/SGA GA=33.5 wks BWT=1236g PT/AGA GA=33.4 wks BWT=1818g	102	101

identifying individual differences and the prevalence of specific ranges of ability. The use of idiosyncratic terms and nonstandard levels of functioning, rather than identifying abilities by using standard descriptions of mental handicap, such as provided by the intelligence classification system developed by the American Association on Mental Deficiency (Grossman, 1983), has made comparisons between studies difficult. Likewise, the lack of studies controlling for SES or noting distinct low birth weight subtypes has further complicated the pursuit of accurate conclusions.

Overall, studies have used intelligence tests that denote a single composite score, rather than a multidimensional score. The Wechsler Intelligence Scales for Children (WISC) and its revised edition (WISC-R) have been the tests most frequently used with school-aged children. As the WISC and WISC-R yield verbal and performance scores, some investigators have looked for a distinct pattern with premature and/or low birth weight infants. In studies controlling for SES at school age, specific patterns have not been evidenced (Hunt, Cooper, & Tooley, 1988; Klein et al., 1989; Lindahl et al., 1988; Neligan et al., 1976; Nickle et al., 1982; Noble-Jamieson et al., 1982; Wallace et al., 1982). Likewise, Hunt et al. (1988) noted WISC-R profiles of premature, low birth weight infants at 8 to 11 years of age to be identical to Kaufman's (1979) proportions of verbal/performance discrepancies. Unfortunately, most studies did not classify their subjects by homogeneous groupings (pre-term AGA, full-term SGA, or pre-term SGA). Only full-term SGA children were assessed (Neligan et al., 1976), and significant profile differences were not evidenced.

Academic Outcomes

Academic achievement has been assessed by few investigators of premature and/or low birth weight infants at school age. Word recognition skills were assessed most frequently, with less emphasis given to written spelling, and mathematical calculation skills. A variety of achievement tests were used, with the Wide Range Achievement Test (WRAT) being the most popular and the Neale Analysis of Reading Ability (a word recognition test) being in distant second place. The results were presented in a number of ways. Some studies compared their subjects to control groups or to test norms by noting test score means, whereas others noted statistical significance without presenting scores. And some researchers identified abnormality by establishing subjectively based cutting scores.

Studies that matched groups to control for the impact of SES and noted test scores had results suggesting that perinatal events affect later academic performance, but mainly to the extent that they were related to intelligence (Drillien, 1980; Klein et al., 1989; Lindahl et al., 1988; Neligan et al., 1976; Nickel et al., 1982; Rubin et al., 1973; Westwood, Kramer, Munz, Lovett, & Watters, 1983; Wiener, 1968; Wiener, Rider, Oppel, & Harper, 1968). Controlling for the effects of SES when comparing groups is important, due to its high correlation to both achievement and ability tests (Sattler, 1988). This relationship, therefore, needs to be addressed, given its impact on the cognitive development of premature and/or low birth weight infants at school age.

With reading recognition skills (Table 7), pre-term, low birth weight children scored 4.7 standard score points below the scores of full-term, normal birth weight controls (Klein et al., 1989; Neligan et al., 1976; Rubin et al., 1973; Westwood et al., 1983; Wiener et al., 1968). Mathematical skills (Table 7) were 7 points below (Klein et al., 1989; Rubin et al., 1973; Westwood et al., 1983; Wiener et al., 1968). Spelling skills (Table 7) were also noted to be significantly less than those of normal controls (Lindahl et al., 1988; Rubin et al., 1973).

Regarding differences between full-term SGA and full-term normal birth weight children, Westwood et al. (1983) noted standard score differences of 6 points for reading recognition, a 5 point written spelling difference, and a 6 point math calculation difference. It also should be noted that Westwood's SGA group came from a higher SES level than his normal comparison group. Comparing ability test means with achievement test means, there is a 3.9 point discrepancy for reading recognition tests, a 9.1 point written spelling discrepancy, and a 15.8 point math calculation discrepancy. Academic outcomes for low birth weight and SGA infants at school age have been followed by only one researcher (Dunn, 1986), and he did not find significant differences between low birth weight and full-term SGA groups of children. Unfortunately, these study groups did not have similar socioeconomic backgrounds, as the low birth weight groups cases came from families whose parents had low educational and occupational levels. Rubin

Table 7: Long-term intellectual and achievement outcomes.

Study	Age (Yr)	Type	IQ	Reading (SS)	Spelling (SS)	Math (SS)	Test
Wiener et al. (1968)	8-12	White <2000g	96.9	91	NS	93.5	WRAT
		Afr. Amer	83.1	73	NS	76.5	
Wiener (1968)	8-12	White 2000-2500g	99.3	98.9	NS	99.2	WRAT
		Afr. Amer.	85.5	73.2	NS	78.7	
		White >2500g	105	102.3	NS	104	
		Afr. Amer.	89.9	78.6	NS	83.0	
Rubin et al. (1973)	7	PT <2500g M	95.4	91	90	91	WRAT
		F	99.1	93	91	91	
		FT >2500g M	103.9	94	91	96	
		F	102.6	101	96	93	
Neligan et al. (1976)	IQ-5	FT/SGA 5%-10% BWT=2710g	94.3	96.7/94.7	NS	NS	SRRT/ HSRT
	AC-7	FT/SGA <5% BWT=2397g	91.3	91.4/90.0	NS	NS	
		FT/AGA	99.7	93.8/93.2	NS	NS	
Drillien et al. (1980)	6.7	SGA or PT, <2000g SES: 1	110	104	NS	NS	BVRRT
		2	105	99	NS	NS	
		3	98	93	NS	NS	
		4	91	83	NS	NS	
		FT/AGA SES: 1	120	113	NS	NS	
		2	109	103	NS	NS	
		3	103	99	NS	NS	
		4	94	86	NS	NS	
Nickel et al. (1982)	10.6	PT <1000g GA=28 wks BWT=910g	90.5	94.2	83.8	92.8	WRAT
		pat. ed. >12 yr	101.5	107.3	NS	89.8	
		< 12 yr	83.3	88.5	NS	79.7	

Table 7: Continued.

Study	Age (Yr)	Type	IQ	Reading (SS)	Spelling (SS)	Math (SS)	Test
Westwood et al. (1983)	13-19	FT/SGA BWT=2188g FT/AGA *AGA SES higher than SGA SES	103.6 108.7	99.7 105.9	94.5 99.0	87.8 94.2	WRAT
Dunn (1986)	IQ-6.5 AC-8	PT/AGA SES: 1-3 *lower SES than SGA & 4 FT/AGA 5 SGA (PT & FT) SES: 1-3 4 5 FT/AGA SES: 1-3 4 5	104.9 99.7 90.5 105.5 95.8 93.6 114.0 110.1 104.8	No significant academic differences between PT/AGA and SGA groups FT/AGA significantly higher than PT/AGA and SGA groups in all areas			SAT
Lindahl et al. (1988)	8-9	LBW GA=37.4 wks BWT=2932g FT/AGA	 113.5 120.2	 8.0 8.0	writing 7.4 8.1	 NS NS	Final test ave.
Klein et al. (1989)	9	PT <1500g GA=30 wks BWT=1190g FT/AGA	92 98	92 No neuro. 97	NS handicap NS	87 96	WJPEB

Key:
SGA = small for gestational age
AGA = apparopriate for gestational age
GA = gestational age mean
WRAT = Wide Range Achievement Test
SAT = Stanford Achievement Test
HSRT = Holborn Sentence Reading Test
SRRT = Schonell Reading Recognition Test
BVRRT = Burt-Vernon Reading Recognition Test
WJPEB = Woodcock-Johnson Psychoeducation Battery (Achievement)

NS = not specified
PT = pre-term
FT = full term
M = male F = female
LBW = low birth weight
BWT = birth weight mean
SES = socioeconomic status
SS = standard score
IQ = intelligence quotient
AC = academics

et al. (1973) attempted to address pre-term and SGA ability/achievement outcomes and to control for SES effects. This did not occur because they established their low birth weight cut-off at <2500 grams, a group with more favorable outcomes. Furthermore, their criteria for SGA (GA <37 weeks and BWT >2500 grams) were above the Dubowitz et al. (1970) 10% ratio. Thus, accurate academic outcomes for full-term and pre-term SGA children are unknown.

Other investigators studied highly selected groups of at-risk children so that their results are not representative of the broader PTAGA population. For example, Klein et al. (1989) studied only PTAGA infants without neurological impairments and Nickel et al. (1982) investigated only infants having birth weights less than 1000 grams. Thus, accurate ability/achievement outcomes for pre-term AGA infants, as well as how they compare with other at-risk groups, are not known.

Research on premature, low birth weight infants have not used the federal definition and criteria to identify specific learning disabilities. To make this even more confusing, different researchers have used subjective criteria to identify learning disabilities with this at-risk population. And many have not addressed academic concerns at all. Likewise, information regarding oral expression, listening comprehension, written expression, basic reading skill, reading comprehension, and mathematical reasoning is unknown for any category of this population while controlling for the influence of socioeconomic factors (Aman & Singh, 1983; Balow, Rubin, & Rosen, 1975/76; Caputo & Mandell, 1970; Cohen, 1986). Furthermore, comparisons between achievement and ability for individual students have been investigated by only one researcher (Hunt et al., 1988). She noted a significant discrepancy (1.5 standard deviation ability/achievement discrepancy for 16.7% of her low birth weight population). However, specific achievement areas were not identified from their WRAT scores.

Consequently, there is a need for investigators to study areas addressed by the federal definition of learning disabilities for homogeneous groupings of premature, low birth weight infants (pre-term AGA, full-term SGA, and pre-term SGA). It is also important that future studies control for socioeconomic factors affecting these at-risk children.

Special Education Outcomes

Researchers (Table 8) have found that the prevalence of mental retardation (IQ less than 70) occurs at a 3% to 8% rate for infants weighing less than 1500 grams (Lefebvre et al., 1988; Nickel et al., 1982; Sell et al., 1985; Stewart, 1983). Unfortunately, these studies did not differentiate between premature AGA, full-term SGA, and pre-term SGA groupings. Also, the populations they followed tended to overrepresent groups from lower socioeconomic levels. Thus, current estimates of mental retardation may present a skewed set of results. Higher prevalence rates (5% to 8%) were generally found for birth weights less than 1000 grams (Kitchen et al., 1980; Nickels et al., 1982; Stewart, 1983) than for birth weights greater than 2000 grams (3% to 6%). Prevalence rates of mental retardation for this population are significantly higher

Table 8: Special education outcomes.

Study	Age	Type	MR	VI	HI	POHI	SLI	LD	NS Prg.
Kitchen et al. (1980)	8	LBW <1500g	15.9%	3.8%	3.7%	2.4%	NS	NS	NS
Nickel et al. (1982)	10.6	PT <1000g	8.0%	VI/HI 16%		8.0%	NS	16.0%	16%
Stewart (1983)	8	LBW <1500g	3.0%	1.0%	3.0%	3.0%	NS	NS	NS
Hill et al. (1984)	12-14	CIMN CIMN <10% BWT	9.0% 17.0%	3.0% 5.5%	NS NS	3.0% 5.5%	9% 17%	NS NS	NS NS
Sell et al. (1985)	3-6	GA=34 wks BWT=2039g NS SGA	2.7%	1.0%	NS	1.0%	5.4%	23.3%	NS
Lefebrve et al. (1988)	5-9	PT or SGA < 1000g	2.7%	NS	8.0%	9.0%	NS	8.0%	NS

Key:
MR = mental retardation
VI = visually impaired
HI = hearing impaired
SLI = speech & language impaired
POHI = physically or otherwise health impaired
LD = learning disabled
NS Prg = not specified special ed. program
CIMN = clinical intrauterine malnourishment

LBW = low birth weight
PT = pre-term
FT = full term
NS = not specified
BWT = birth weight mean
GA = gestational age
SGA = small for gestational age

than the overall 1% to 2% incidence noted by the U.S. Department of Education (1984). Although mental handicaps have long been the focus of study, it has been difficult to compare and integrate these findings into a clear picture because of the lack of standardization of sampling and test procedures, as well as with problems in accurately reporting the degree of retardation (Teberg et al., 1988).

Higher prevalence rates than the United States population have been noted for all other areas (Table 8) of special education handicaps. For example, visual impairment ranged from 1% to 5%; profound hearing impairment ranged from 3% to 4%; and physical or other health impairments occurred in 1% to 8% of their at-risk subjects according to Kitchen et al. (1980), Nickel et al. (1982), Hill et al. (1984), Lefebvre et al. (1988), Sell et al. (1985), and Stewart (1983). This compares to an .08% to .07% rate of visual impairment, a .14% incidence of orthopedic impairment, and a .13% rate for health impairment (U.S. Department of Education, 1984). Specific perinatal events were generally cited as responsible for many of these severe handicapping conditions according to Behrman et al. (1983) and Korones (1986). For instance, high bilirubin counts related to deafness, seizures, and/or grade 3 to 4 intracranial hemorrhages related to cerebral palsy, and retrolental fibroplasia due to too much oxygen at birth caused visual impairments.

When looking at less severe handicaps (Table 8), speech and language impairment was found to range between 5% and 17% for PTAGA and PTSGA children (Hill et al., 1984; Sell et al., 1985). Hill et al. (1984) found 17% of their

SGA infants received special education services in this area, with Sell et al. (1985) noting 5% of her neonatal intensive care graduates getting this assistance. These results compare with a 2% to 3% national incidence rate (U.S. Department of Education, 1984). With specific learning disabilities (Table 8), rates varied from 8% to 23% (Lefebvre et al., 1988; Nickel et al., 1982; Sell et al., 1985), compared to the United States population incidence rate of 4% to 4.4% (U.S. Department of Education, 1984). However, the few studies that noted LD prevalence rates were limited by the fact that the populations being assessed were either highly selected (Nickel and Lefebvre studied only infants weighing less than 1000 grams, with an overrepresentation of lower socioeconomic level subjects), or too general (Sell followed an undifferentiated population of neonatal intensive care graduates, with no data available regarding SGA infants, race, or SES).

Despite the lowering of mortality and morbidity rates with premature, low birth weight infants and the increase in research on intellectual functioning and educational sequelae, there is a need to learn more about the prevalence and etiology of many of their resulting handicaps, particularly the less severe outcomes.

Grade Retention

Grade retention rates for premature and/or small for gestational age infants have largely been ignored in most long-term studies. Perhaps because of differences in educational systems or cultural backgrounds, researchers in Japan, the United Kingdom, and Australia have not addressed this issue. Likewise, Shepard and Smith (1989) reported that essentially no children are retained annually in these countries. In the United States, researchers note retention rates from 17% (Rubin et al., 1973) for pre-term infants at 7 years of age to 55% (Wiener, 1968) at 12 to 13 years of age. Unfortunately, these studies did not specify SES or at-risk groupings for these children. Klein et al. (1989) noted that for an average SES group of infants weighing less than 1500 grams at 9 years of age, 40% had repeated a grade. This rate compares to an 11% rate for a matched group of full-term, normal controls. Thus, it appears that low birth weight children do have difficulty progressing through the graded school systems of the United States. However, information is not available to differentiate between small for gestational age and premature infants' grade retention outcomes.

To further complicate the grade retention issue, there are no comprehensive data documenting the numbers of children retained by grade each year. Rose, Medway, Cantrell, and Marus (1983), however, collected retention rates for the 1979-80 and preceding school years from the 15 states that had gathered this information. The states, primarily from the South, reported average yearly retention rates ranging from 3.5% (Arizona) to 8.9% (Mississippi). Because a number of the states had retention rates larger than 100%, it was assumed that at a minimum, 15% of the retentions were individuals repeating for a second time. Thus, over the 13-year school period, 30.5% to over 100% of these states' students were retained.

Regarding retention rates for LD children in Indiana during the 1987-88 school year, McLeskey and Grizzle (1992) found that 54% of the third-grade LD students and 61% of the sixth-grade LD students had been retained. Based on a stratified random population sample of Indiana students from similar-sized school districts and geographical locations, these investigators found that 25% of the third graders and 26% of the sixth graders had been retained.

According to Klein et al. (1989), it appears that premature and low birth weight children are more at-risk of being retained during their school years in the United States than normal children. However, it is unknown how much higher their retention rate is than that of the general population, or whether it is higher than that of children with disabilities who do not have a history of prematurity and/or low birth weight.

Gender and Race-Related Influences

Although there appears to be a tendency toward lower mean IQ scores (2 to 4 points) for undifferentiated groups of male pre-term and SGA infants (Dunn, 1986; Eaves et al., 1970; Portnoy, Callias, Wolke, & Gamsu, 1988; Rubin et al., 1973; Wallace et al., 1982), these findings have been disputed. Francis-Williams and Davies (1974) noted that males have a 6 to 7 point advantage. However, these studies' results rarely approached statistical significance. Regarding gender differences for pre-term AGA infants, Neligan et al. (1976) found none. And for SGA children, the results were contradictory. Fitzhardinge and Steven (1972) found females to score 6 IQ points higher than males, whereas Neligan et al. (1976) noted males to perform 2 IQ points better. Unfortunately, these investigators did not control for SES. Only Rubin et al. (1973) identified SES groupings by gender. Their results noted a nonsignificant 3.7 IQ point advantage for pre-term, low birth weight (<2500 grams) females. However, these young girls were from lower socioeconomic levels than pre-term male comparisons. Therefore, one might conclude that there may be a tendency toward lower male IQ performance, but controlled data regarding specific results for all groups of premature and/or low birth weight infants are lacking.

Regarding gender-related academic differences for premature and/or low birth weight infants, little is known about the specific performance of these at-risk children. Current studies generally have focused on relatively heavier pre-term children (birth weights less than 2500 grams). Rubin et al. (1973) found no gender differences in reading recognition, spelling and math calculation skills. Wallace et al. (1982) found no differences when assessing reading recognition skills. Dunn (1986) identified significant reading recognition and spelling differences favoring females at only the fourth-grade level, but noted consistent writing differences for the third through fifth grades. Because Rubin et al. (1973) were the only researchers to address socioeconomic influences, little is known about male-female differences for this at-risk population.

Concerning racial influences for low birth weight infants, only one study (Wiener et al., 1968) assessed intellectual outcomes. These investigators found a 14 point IQ difference between White and African American infants. However, these results must be viewed with great caution as the study did not control for socioeconomic factors.

With academic outcomes, only one study (Wiener, 1968) assessed African American and White low birth weight infants. White children weighing between 2000 and 2500 grams at 10 to 12 years of age had a 26 point standard score advantage for reading recognition skills. Infants weighing less than 2000 grams had an 18 standard score point reading recognition advantage. A similar trend was noted for math calculation skills (2000 to 2500 grams: 21 point advantage, <2000 grams: 17 point advantage). However, regression analysis noted that socioeconomic class was the most important variable regarding academic achievement for these children.

Studies identifying special education handicap rates by race or gender for premature and/or low birth weight infants have not been pursued.

Learning Disabilities

Like premature, low birth weight infants, specific learning disabilities have been difficult to assess because they also represent a heterogeneous population with numerous, complex, and sometimes conflicting etiologies (Aman & Singh, 1983; Cohen, 1986; Hammill, 1990; Keogh, 1982). Aman and Singh (1983), for example, have identified brain damage, maturational lag, genetic inheritance, cerebral dominance, and ocular system factors (dominant eye, abnormal eye movements, and visual perception) as physiological bases of etiology, with personality and environmental factors (social class, family size, geographical location, and instruction) as nonphysiological bases.

In addition to classification systems based on etiology, McKinney (1987) noted that specific learning disability subtyping research represents a promising approach in understanding this heterogeneous population from the perspective of dividing it into more homogeneous groups that reflect specific patterns of disability. McKinney described classification systems based on ability profiles, IQ/achievement discrepancies, academic performance, neuropsychological development, and functioning patterns, using multivariate statistical techniques. Unfortunately, the vast majority of these studies used clinic-referred samples that were not representative of the general population, or did not control for such important variables as age, race, gender, or SES. Another problem with subgroup research involved the issue of external validation. For example, most of the neuropsychological studies did not link their subtypes with actual academic performance or learning disabilities. And last, there is a need for researchers to assess stability of subtype membership or the relationship between subtypes and long-term academic outcomes. With these limitations in mind, McKinney noted general consensus among these studies regarding the following subgroups: (a) visual perceptual/perceptual-motor process deficits and average to above-average language abilities, (b) linguistic and auditory process deficits with intact perceptual and/or perceptual-motor skills, (c) mixed perceptual/linguistic deficits, and (d) normal-appearing individuals. The normal subgroup also includes concerns with motivation, pedagogical factors, attention disorders, and memory deficits.

Likewise, Sameroff and Chandler (1975) noted three possible models of development that may explain specific learning disabilities: (a) a main effect model that involves specific causal factors (environmental or constitutional influences), (b) an interaction model that views development as a function of the contribution of both constitutional and environmental factors that affect each other, and (c) a transactional or reciprocal model that proposes, for example, that biological risk is not the most significant factor in the outcome of neurological impairment, but it is the nature of the transactions within the social milieu where a child grows up. In other words, a child with an impairment and his environment change each other; thus, it is not possible to use a main effect model or an interactive model to understand development.

In the pursuit of addressing each etiology and attempting to be comprehensive, numerous definitions of specific learning disabilities exist. Unfortunately, researchers following premature, low birth weight infants have not consistently used any specific developmental model or definition, and have not followed the predominant educational definition and its criteria followed in the United States. Public Law 94-142, the Education for All Handicapped Children Act of 1975, defines specific learning disability as follows:

> a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, speak, read, write, spell, or to do mathematical calculations. The term includes conditions as perceptual

> handicap, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. The term does not include children who have learning disabilities which are primarily the result of visual, hearing, or motor handicaps, or mental retardation, or emotional disturbance, or environmental, cultural, or economic disadvantage. (USOE, 1977, p. 65083)

The 1977 Federal Register further set the criterion that there must be a severe discrepancy between achievement and intellectual ability, although the amount of discrepancy and specific procedures were left to the states to determine. Currently, all states quantify a severe discrepancy by using at least one of four methods (Frankenberger & Harper, 1987). They are: (a) deviation from grade score, (b) expectancy formulas, (c) standard score comparisons, and (d) regression analysis. Standard score comparisons were the most widely used.

LD Characteristics--Epidemiological Studies

Of the large-scale prospective epidemiological studies that identified learning disabilities for basic reading skills by using a discrepancy model, prevalence rates varied according to cutting scores used and geographical locations. Rutter and Yule (1975) used a 2 or more standard deviation difference between ability and achievement with a regression formula, and found a 2.28% rate on the Isle of Wight and a 6.3% rate in inner London for 9 to 10 year olds. Gjessing and Karlsen (1989) used a 1 to 1.5 standard deviation discrepancy with a regression formula and found a 5% incidence for Norwegian second graders and a 2% incidence for ninth graders. Both studies noted a 3:1 disability ratio in favor of males, significantly more reading difficulties among first-degree relatives, and significant speech and language delays. Rutter and Yule noted lower verbal IQ than performance IQ scores, larger family sizes, and a slight tendency toward premature births and low birth weights relating to reading retardation. Whereas Gjessing and Karlsen noted dyslexia to be correlated with poor fine and gross motor coordination, fine tactile sensation difficulties, problems with left-right discrimination, concentration concerns, and a higher incidence of behavioral and emotional problems. Unfortunately, these researchers did not assess prematurity and low birth weight factors.

Of retrospective studies noting below grade level academic results, Kawi and Pasamanick (1959) noted reading disorders occur much more frequently with children having perinatal abnormalities. However, this clinic-based population study did not take SES into account. Malmquist (1958) also found significant ($p < .05$) relationships between low birth weight and prematurity, and poor reading. Likewise, SES was not addressed in this Swedish study.

Socioeconomic Status and Learning Disabilities

The relationship of SES to learning disabilities for school-aged children remains a largely unstudied area with little empirical data. In contrast, there is much evidence that higher SES/LD students have better educational, employment, and occupational outcomes as adults than lower SES/LD individuals (Schouhaut & Satz, 1983; Spreen, 1988). Regarding the school-age LD population, only the large-scale epidemiological studies from England (Rutter & Yule, 1975) and Norway (Gjessing & Karlsen, 1989) directly address the LD/SES issue. Both sets of researchers defined SES on the basis of paternal occupation alone. Rutter and Yule (1975) determined reading retardation or learning disabilities in an approach similar to the current federal LD definition and criteria. They found a slight tendency for reading retardation to be less common in children of nonmanual workers, rather than an excess of identified children from lower social classes in their Isle of Wight and inner London studies. They also noted a strong association between larger families and parents with poor reading skills to reading retardation. Gjessing and Karlsen (1989) found that SES accounted for only 20% of the variance relating to dyslexia. They thought this low relationship was based on Norwegian demographics; Norway is culturally and socioeconomically more homogeneous than the United States.

The fourteenth annual Report to Congress on the Implementation of the Individuals With Disabilities Act (U.S. Department of Education, 1992) suggested that SES and racial factors may be related to higher incidences of learning disabilities and other special education handicaps. Specifically, 21.6% of secondary LD school children are African American, whereas only 12% of the general population of secondary school children are African American. This same report found that 57% of African American youth, 49% of Hispanic youth, and 25% of White youth were from families earning less than $12,000 per year. Research has shown that children living in poverty or from low SES families are less likely to receive adequate health care and nutrition. And poor health care and nutrition are related to increased incidences of developmental delays and disabilities (Children's Defense Fund, 1991). However, this implication is contradicted by data identifying 8.4% of secondary school LD youth as Hispanic versus 13% of the general population of secondary school children as Hispanic. In comparison to national handicap rates, Hispanic youths are underrepresented in other impairment areas (mental retardation--5%, emotional impairment--6%, multiple disabilities--12.1%, hearing impairment--11.5%, visual impairments--8.1%, and deaf-blindness--5.8%). Hispanics are overrepresented for only orthopedic impairments (15.1%) and other health impairments (22.5%). Thus, special education data documenting the relationship of SES to disability are unclear.

Regarding regression analysis studies predicting intellectual and academic achievement performance from socioeconomic and perinatal factors, Rubin and Balow (1977) noted maternal age, education, and SES to be correlated with IQ at 7 years ($r = .47$), WRAT reading at 7 years ($r = .40$), SAT spelling at 9 years ($r = .36$), and SAT arithmetic and 9 years ($r = .34$). Neonatal variables had weaker correlations with IQ ($r = .23$), WRAT reading ($r = .23$), SAT spelling ($r = .25$), and SAT arithmetic ($r = .25$). These findings support SES-related results regarding IQ and achievement outcomes for White subjects from the Collaborative Project (Broman, Nichols, & Kennedy, 1975) and the British National Child Development Study (Davie, Butler, & Goldstein, 1972). Correlations at age 7 consistently fell between 0.24 and 0.42 and accounted for 6% to 17% of the variance.

Looking at the special education data in the United States, Satz and Friel (1974) noted a tendency of low SES to correlate with learning disabilities, when trying to establish an early risk index factor at the kindergarten level. Concerning LD prevalence rates from the 1978 and 1980 Civil Rights Survey of Elementary and Secondary Schools, Gelb and Mizokawa (1986) found comparable results for Whites (3.2%), African Americans (3.2%), and Hispanics (3.2%) versus the national rates (3.2%). Only Asian (1.4%) and American Indian (4.1%) groups had variable prevalence rates. However, the relationship between race and learning disabilities was not assessed. Gelb and Mizokawa (1986) attempted to investigate the SES/LD relationship using these surveys and 1970 census data. Their SES indices included children below the poverty level, infant mortality, public aid, average family income, and educational costs. Learning disability identification was positively related to family income and educational costs, and negatively related to living below the poverty level and dependence on public welfare.

Research-based conclusions regarding SES and learning disabilities were also conspicuously absent in textbooks on the subject (Adamson & Adamson, 1978; Adelman & Taylor, 1983; Clarizio & McCoy, 1983; Gelfand, Jenson, & Drew, 1982; Lerner, 1981; Mercer, 1983). Of those texts that addressed this relationship, Gelfand et al. (1982) discussed the issue from a broad perspective, noting "it is evident that environmental influence has played an important role in psychological theories and research. This has affected the field of learning disabilities as well. Precise identification of environmental impact remains elusive" (p. 225). Clarizio and McCoy (1983) addressed the incidence of specific learning disabilities in relation to SES, noting the "research is difficult to interpret" (p. 213). They further noted that some authors have found a higher frequency of learning disabilities for upper-class children, suggesting that these families were possibly better able to afford professional evaluations and treatment. Unfortunately, there were no other systematic attempts to assess learning disabilities and socioeconomic factors. Consequently, empirically based conclusions cannot be drawn at this time.

Review of Literature Summary

1. From the 1960s, both mortality and major handicap rates have decreased for premature and/or low birth weight infants. Currently, 7% of those surviving birth in the United States weigh less than 2500 grams, and approximately 1% weigh less than 1500 grams. There is a 25% to 45% mortality rate, and 8% to 19% prevalence of moderate to severe handicaps for infants weighing less than 1500 grams. Decreases in these rates have been attributed to improvements in pediatric care, obstetric advances, and innovations in medical technology.

2. Questions remain regarding the prevalence and etiology of less severe handicaps, particularly specific learning disabilities. This is a particular concern as some authors have predicted that the numbers of children with less

severe handicaps will increase with the decrease in mortality and major handicap rates.

3. Studying premature and/or low birth weight infants regarding educational handicaps has proven difficult due to this group's heterogeneity. Current classification schemes involve gestational age and birth weight criteria. Three patterns have been identified: (a) premature infants who are appropriately grown for their gestational age, (b) small for gestational age and born at or later than 37 weeks, and (c) premature, small for gestational age.

4. Learning disabilities have been difficult to assess because it represents a heterogeneous population with numerous, complex, and sometimes conflicting etiologies. Unfortunately, researchers following premature and/or low birth weight infants have not consistently used any specific developmental model or definition of learning disabilities. And they have not used the predominant educational definition and criteria mandated in the United States, as noted by Federal Law 94-142.

5. Large-scale prospective epidemiological studies have identified learning disabilities using a discrepancy model and regression analysis. Prevalence rates varied from 2% to 6% depending on cutting scores, geographical setting, and age. LD boys outnumbered girls by a 3:1 ratio. Likewise, LD children had more first-degree relatives with reading problems, and had significantly more speech and language problems than normal comparisons.

Regression analysis found maternal age, education, and SES to be more highly correlated with intellectual and academic outcomes than perinatal factors.

6. The relationship between SES and learning disabilities remains a largely unstudied area, with few empirically based conclusions.

7. Intelligence test scores of premature and/or low birth weight infants were lower than those of full-term, normal birth weight infants by 7.4 IQ points, on average. It was also found that pre-term, low birth weight infants from lower socioeconomic groups score, on average, 14 IQ points lower than infants from middle- and upper-class groups at 4 to 10 years of age. Likewise, the effects of an adverse socioeconomic environment progressively impact IQ from 2 years onwards.

8. Full-term SGA infants have IQs 5.6 points lower, on average, than full-term, normal birth weight comparisons. Pre-term SGA infants are 12.5 points lower, and pre-term AGA infants are 11.8 points lower. Comparisons between premature SGA and premature AGA infants were contradictory, possibly due to methodological concerns.

9. Academic achievement of premature and/or low birth weight infants at school age has been investigated by few researchers. Word recognition skills have generally been evaluated most frequently, with much less emphasis given to written spelling and mathematical calculation skills.

10. Reading recognition skills for preterm and/or low birth weight children were 4.7 standard score points below full-term normal birth weight

controls, and 7 points lower on mathematical calculation tests. Accurate academic outcomes for full-term SGA and pre-term SGA children are unknown. No investigator has used the federal definition and criteria to study learning disabilities with this at-risk population.

11. Higher prevalence rates have been found for all categories of educationally defined special education handicaps for premature and/or low birth weight infants at school age. However, it is difficult to draw valid conclusions due to the lack of standardization of at-risk types, variable test procedures, and studies not controlling for the effects of SES.

12. Grade retention rates for premature and/or low birth weight children at school age have generally not been studied. Furthermore, rates for the general population have not been systematically assessed.

13. Regarding gender-related influences, there is a tendency for lower male IQ performance for premature and/or low birth weight infants. However, there is little data to support this relationship with academic outcomes.

CHAPTER III

METHODOLOGY

Rationale

In attempting to answer the questions that were generated in the previous sections, two general areas of investigation were pursued. The first area of research addressed descriptive long-term outcomes for three distinct groups of premature, low birth weight infants (premature AGA, full-term SGA, and premature SGA infants). This study identified prevalence rates for special education handicaps for these groups by their gender, socioeconomic status, and age at the time of the referral and then made comparisons to local handicap rates. A systematic analysis of these groupings' outcomes was attempted to better define their prognosis at school age. While previous studies have focused on neonatal outcomes for specific birth weights and gestational ages of at-risk infants, this study further described characteristics such as handicaps using current federal special education criteria and definitions, grade retentions, special services and programs, and the chronology of program decisions for the three groupings. This information can assist practitioners in the fields of education, psychology, and medicine to make more informed decisions for these children and their care-giving institutions.

The second part of the study was designed to look more closely at the long-term outcomes of less severe handicaps, or learning disabilities, for these three distinct groups of at-risk infants. To control for school district IEPC eligibility decisions and examiner differences, ability/achievement discrepancies (using both standard score differences and regression analysis models to determine the severity of ability/achievement discrepancy) were computed using independent testing results. This study then compared the at-risk groups' ability and academic achievement test results, and learning disabilities. To control for maturational factors, gestational ages were matched for premature AGA and SGA groups. To compare premature AGA and full-term SGA infants, subjects were matched by their birth weights. Subjects in these groups were also matched on the basis of age, gender, and SES. Unlike previous studies that have not controlled for these factors, it was anticipated that questions pertaining to how these at-risk groups compare with each other could be accurately addressed. The comparisons of discrepancies and learning disability incidence obtained by using different procedural models should help practitioners from different theoretical perspectives better understand outcome results.

Another major difference between this study and previous research in this area involved comparing high and low SES groups of pre-term AGA and SGA infants matched on the basis of gender, age, and SES. Gender differences were also investigated. There was no reliable information regarding these concerns for the three at-risk groups, as well as for LD students in general.

This study investigated whether these at-risk infants displayed a distinct pattern of learning disabilities in comparison to the general population. LD preterm and LD SGA children were compared with a local LD population matched on the basis of gender, age, and SES. Unlike previous studies that assessed reading recognition, spelling, and math calculation skills versus intellectual ability, this study used the more comprehensive current LD educational definition, which included reading recognition, reading comprehension, written expression, math reasoning, and math calculation. Using this broader definition allowed for exploration of specific patterns of learning disabilities.

Finally, perinatal and socioeconomic variables were assessed in relation to LD outcomes for psychometrically and school certified LD students. These variables included race, gender, family marital status, maternal and paternal education, maternal and paternal occupation, birth order, family size, low birth weight, prematurity, intrauterine growth retardation, episodes of otitis media, birth asphyxia, length of Intensive Care Unit (ICU) hospitalization, need for and time on ventilator, grade of intracranial hemorrhage, and seizures. Because learning disabilities have various etiologies, it was important to discern the strength of this condition's relationships to possible influential factors.

Definitions and Formulas

Method 1: Standard Score Discrepancy

Currently, most states use a standard score discrepancy model (Frankenberger & Fronzaglio, 1991) in comparing IQ and academic achievement when determining learning disabilities. Typically, a specific value was selected as the eligibility criterion by individual school districts. Academic achievement/ ability test discrepancies of 18 to 22 standard score points are typically used to qualify children as LD in the mid-Michigan area.

Method 2: Regression Analysis

The next most widely used method in identifying LD students (Frankenberger & Fronzaglio, 1991) involves a regression analysis procedure outlined by Wilson and Cone (1984). For purposes of comparison with other regression analysis methods, it was assumed that the mean standard score for the population being sampled is 100 and the standard deviation is 15 for each test used. A 0.6 test intercorrelation level was used, based on Reynolds's (1990) recommended formula

$$(r_{xy} = \sqrt{0.5}\ \sqrt{r_{xx} r_{yy}})$$

when r_{xy} is unknown. Wilson and Cone (1984) suggested the following regression equation:

$$\hat{Y} = r_{xy}\ Sy/Sx\ (IQ - \bar{X}) + \bar{Y}$$

where $\hat{Y}$ = the expected achievement for a given IQ

r_{xy} = the IQ - achievement correlation

Sy = the standard deviation of the achievement scores

$\bar{X}$ = the mean IQ

Sx = the standard deviation of the IQ scores

$\bar{Y}$ = the overall mean achievement

Hypotheses

Based on the previous observations and considerations, the following hypotheses were tested.

1. The incidence of special education handicaps in all categories was thought to be higher for pre-term AGA, full-term SGA, and pre-term SGA than the general local population. No differences were anticipated between pre-term AGA and SGA rates, and full-term SGA students were expected to have a lower proportion of special education eligibility than the other at-risk groups. Furthermore, it was anticipated that gender-related incidences would reflect local population patterns, whereas lower SES groups would be overrepresented by higher rates of special education outcomes.

2. Premature and/or low birth weight children were thought to receive more special services, be retained at a higher rate, and be involved with special programs at earlier ages than the general population. Full-term SGA students would be involved with fewer services and programs than pre-term SGA and AGA children.

3. It was hypothesized that there would be a greater proportion of psychometrically identified LD students using both regression analysis methods and standard score discrepancy methods in determining a significant discrepancy between IQ and academic achievement for pre-term AGA and SGA students than IEPC identified students. It was anticipated that matched PTSGA IQ and achievement test means would be significantly lower than matched PTAGA

results. This pattern was postulated to continue with PTAGA test results being higher than matched FTSGA scores. Furthermore, it was thought that there would be a greater number of significant ability/achievement discrepancies, and they would be more severe for pre-term AGA children than full-term SGA children. Likewise, PTSGA infants would have a greater number of and more severe ability/achievement discrepancies than PTAGA students.

4. It was thought that there would be more psychometrically identified learning disabilities with lower SES premature and/or low birth weight children using standard score and regression analysis methods than matched groups of higher SES pre-term and/or low birth weight children. Likewise, it was anticipated that there would be a greater number of and more severe ability/achievement discrepancies using regression analysis and standard score methods for lower SES at-risk children than matched at-risk children from higher SES groups. It was also thought that lower SES subjects would have significantly lower ability and achievement test scores than a matched group of at-risk higher SES children.

5. It was hypothesized that there would be significant differences between at-risk LD subjects identified by IEPCs and a matched group of local LD students with normal neonatal backgrounds. It was thought that at-risk children would have significantly lower ability and achievement tests, more severe ability/achievement discrepancies, and greater numbers of academic discrepancies.

6. It was postulated that prenatal and perinatal factors would be significantly related to learning disabilities for both psychometrically and IEPC identified LD subjects. Prenatal and perinatal factors included low birth weight, intrauterine growth retardation, episodes of otitis media, birth asphyxia, length of ICU hospitalization, need for and time on ventilator, grade of intracranial hemorrhage, and seizures.

Subjects

The preliminary subject pool for this study was established by identifying all premature and/or low birth weight infants born at Sparrow Hospital in Lansing, Michigan, and placed in its Regional Neonatal Intensive Care Unit (RNICU) from January 1, 1977, to January 1, 1984. Prematurity was defined as birth at 37 weeks gestation or earlier. Small for gestational age (SGA) was characterized by a 10% or less birth weight on standard population growth curves at birth. In addition to these defining features, subjects were also formally diagnosed by hospital neonatalogists. Infants transferred into the hospital's RNICU were not included in this study because of the many uncontrolled variables associated with the decision to transport at-risk infants to regional neonatal intensive care facilities from smaller hospitals, as well as their highly variable outcomes (McCormick, 1989). In addition to these inclusion criteria, study subjects needed to have been regularly followed by Sparrow Hospital's Developmental Assessment Clinic (DAC) until at least 5 years of age. The AGA and SGA subjects were obtained from this pool of monitored children.

Twenty-five FTSGA and 48 PTSGA children were located and questionnaires and consent forms sent to their parents. After obtaining permission from the children's parents and Sparrow Hospital, medical records and school files were reviewed. Fifty-six percent of the FTSGA and 54% of the PTSGA families consented to be included in the study. PTAGA subjects were chosen on the basis of matching characteristics with SGA subjects. Specific matching criteria included no more than 2 week gestational age differences, no more than 250 grams weight differences, and not more than a 4 month difference in the date of birth was allowed. For SES matching criteria, only a one-level discrepancy was allowed. Tables 9, 10, and 11 show the descriptive statistics for the study's subjects and groupings regarding gender, race, family SES, grade placement, and averages and ranges of birth weights and gestational ages.

A total of 42 premature AGA infants, 26 pre-term SGA infants, and 14 full-term SGA infants were followed until they were approximately 8 to 14 years of age. White children represented the vast majority (92%) of the children in the population, which contrasts with U.S. Census data that showed African American and other minorities made up over 25% of the total population (1980 Census of Population). Further examination of Table 9 shows that subjects in the upper-middle and middle-class groups were overrepresented. The underrepresentation of minority, lower-middle class, and lower-class children may possibly have been related to difficulties in participating in long-term hospital follow-up visits, reluctance to become engaged in research studies, or the inability of this

Table 9: Subject characteristics.

Characteristic	PTAGA	PTSGA	FTSGA	Total
Gender				
Male	23	13	4	40
Female	19	13	10	42
Total	42	26	14	82
Race				
White	40	23	13	76
Black/Other	2	3	1	6
Family SES				
Level 1	7	4	1	12
Level 2	22	10	9	41
Level 3	10	6	2	18
Level 4	1	6	2	9
Level 5	2	0	0	2
Grade Placement				
2nd grade	0	0	2	2
3rd grade	7	5	2	14
4th grade	8	4	2	14
5th grade	4	3	1	8
6th grade	10	5	3	18
7th grade	5	3	2	10
8th grade	8	5	2	15
Ungraded	0	1	0	1

Table 10: Matched groups' characteristics.

Characteristic	PTSGA & PTAGA	FTSGA & PTAGA	Higher SES & Lower SES	At-Risk LD & Local LD
Gender				
Male	13	4	8	10
Female	8	7	8	6
Total	21	11	16	16
Family SES				
Level 1	3	0	3	0
Level 2	9	7	5	5
Level 3	4	4	0	6
Level 4	5	0	6	5
Level 5	0	0	2	0
PTSGA	21	0	6	1
FTSGA	0	11	4	3
PTAGA	21	11	6	4
FTAGA	0	0	0	8

Table 11: Birthweights/gestational ages.

PTAGA		
Birthweight ave.:	2093.03g	Range: 964g-3345g
Gestational age ave.:	34.028 wks.	Range: 27.0-37.0 wks.
Age:	8.1 yrs.-13.7 yrs.	
PTSGA		
Birthweight ave.:	1322.5g	Range: 538g-2070g
Gestational age ave.:	33.577 wks.	Range: 27.5-37.0 wks.
Age:	8.4 yrs.-13.9 yrs.	
FTSGA		
Birthweight ave.:	2225.9g	Range: 1450g-2730g
Gestational age ave.:	39.31 wks.	Range: 38.0-42.5 wks.
Age:	7.10 yrs.-13.0 yrs.	
Pooled/PTAGA, PTSGA, FTSGA		
Birthweight ave.:	1871.4g	
Gestational age ave.:	34.787 wks.	
Age:	7.10 yrs.-13.9 yrs.	

researcher to locate families over time as their involvement with the hospital was over. Gender representation was generally equal for PTAGA and PTSGA subjects. However, females were overrepresented for FTSGA subjects by a greater than 2:1 ratio. Average birth weights and gestational ages were comparable to previous studies' averages that compared these at-risk groups of infants.

A comparison group of LD students (matched on the basis of age, SES, and having no history of premature birth or being small for gestational age) was obtained from the Eaton Intermediate School District. All of these students were evaluated by Michigan certified school psychologists. Individual intelligence and achievement tests, as well as other special education evaluations and records, were reviewed after obtaining consent from the Eaton Intermediate School District and the parents of individual LD children.

Local special education populations were determined by compiling handicap rates from Ingham Intermediate School District, Eaton Intermediate School District, Shiawassee Intermediate School District, and Clinton Intermediate School District. These districts were chosen because 86% (71 of 83) of the subjects resided within them.

Subjects were followed from approximately 8 to 14 years of age because of the difficulty in establishing accurate ability/achievement discrepancies at earlier ages, and due to the fact that the majority of LD students are identified by the fourth grade (D'Amato, Dean, Rattan, & Nickell, 1988).

Procedures

The data for this study were obtained by reviewing each subject's DAC file and school cumulative records. Following discharge from the RNICU, infants were followed by the Developmental Assessment Clinic personnel. Current functioning levels were assessed beginning around 6 months of age and continuing until 7 years of age at regular intervals. Most subjects were examined on a yearly basis. On the recommendation of the neonatalogists, children from distant areas, having less serious medical backgrounds, or followed by other medical clinics were followed every 18 months. On each visit to the DAC, the child and his or her parent(s) were seen by certified or licensed personnel (audiologists, school psychologists, physical therapists, neonatalogists, and pediatric nurses). In addition to evaluations by each of these professionals, current physical weights and measurements were obtained for each child.

Psychological functioning was assessed, depending on the age of the child, by the Bayley Scales of Infant Development, the Stanford-Binet Intelligence Scale: Form L-M, or the Stanford-Binet Intelligence Scale: Fourth Edition, and the Wide Range Achievement Test or Wide Range Achievement Test--Revised (when the child reached school age). After each visit, the scores for each child along with descriptive behavioral observations were recorded in the child's DAC records. RNICU discharge summaries and neonatalogist overview reports of individual DAC visits were also included in each child's file.

The investigator, a Michigan certified school psychologist, reviewed each child's cumulative educational file (CA 60). This allowed for the retrieval of group achievement test data, records of grade retentions, involvement in supplemental or special education programs, special education reports and plans, as well as the chronology of service decisions. The most recent test scores for each subject were used to compare intelligence and academic achievement test results. Typically, this procedure involved comparing an individually administered intelligence test completed when a child was 6 to 7 years old at the DAC, with a group achievement test administered during the 1990-91 school year. Occasionally, a subject's last achievement test was an individually administered instrument. When this occurred, grade norms were used. This practice was used because group achievement tests all utilized grade-based norms.

Retention was defined as a child's nonentry into school. Therefore, to be considered retained, it was not necessary that children be involved in developmental kindergartens, young 5's programs, or that their school or parent had retained them. Rather, retention was based solely on the subject's age in comparison with the common standard of being 5 years old on the first day of kindergarten.

Because information documenting SES was not always gathered by the DAC or noted in school records, a questionnaire and consent to review files was sent to the family of each prospective subject. In this questionnaire (Appendix A), specific information was requested regarding parental occupation, family composition, and highest level of education for each family member. SES was then determined by using Hollingshead's (1975) index. This index was validated by analyzing data from the 1970 U.S. Census. SES levels were obtained by scaling the education and occupation of parents, and noting family composition.

Data Analysis

Data collected dealing with categories of special education eligibility, test results, remedial programs, grade retentions, and models of learning disabilities were analyzed using frequency counts, percentages, and other descriptive statistics. Data not specifically discussed in the results and discussion chapter are located in extended tables (Appendix J). Psychological and educational tests were compared, when necessary, by converting their standard scores to a mean of 100 and a standard deviation of 15. To determine the significance of differences between variables for premature and/or low birth weight groups, as well as matched groupings, t-tests were calculated. Critical values of statistical significance were based on p values being equal to or less than .05.

Multiple regression analysis and Pearson product moment correlations were used to determine the relationships between variables related to learning disabilities.

Limitations

Perhaps the most important limitation of this study is the nonrandom nature of the sample of children being investigated. The students are not representative of the United States population according to their ethnic backgrounds, gender, SES, or geographical residence. In comparison with previous research on premature and/or low birth weight children at school age (Tables 5 and 6), this study's population was comparable on the basis of numbers of subjects, birthweight, gestational age, and gender. However, this at-risk group had more upper-middle-level SES subjects than Drillien (1970), Pena et al. (1987), and Robertson et al. (1990).

A second limitation of this research was related to its long-term nature and attrition problems. Fifty-six percent of the FTSGA and 54% of the PTSGA families consented to be included in the study. A number of subjects were lost due to their parents' deciding not to participate in the hospital's periodic follow-ups and the DAC. Others were lost because they left the mid-Michigan area without leaving forwarding addresses. And still more were not included in the study because their parents decided against consenting to allow their children's records to be reviewed. Consequently, the relatively low number of subjects available for this long-term study limited the scope and depth of possible statistical procedures and analysis, as well as intergroup comparisons for these at-risk children. Also, the relatively low numbers limited the power of statistical procedures.

Third, checking for examiner accuracy in scoring the various tests was not possible. Data collected for this study consisted principally of reports and some test protocol face sheets. Therefore, it was not possible to perform a random check to determine the accuracy of the various test scores.

A fourth limitation involved the current educational classification system noting learning disabilities. The standard score ability/achievement discrepancy procedure predominantly used in Michigan best predicts achievement levels with IQs between 90 and 129 (Dore-Boyce, Misher, & McGuire, 1975). It underidentifies low-ability students and overidentifies high-IQ students due to the regression toward the mean effect (Beck, 1984; Cone & Wilson, 1981; Shepard, 1980). Likewise, Michigan and other states have eligibility criteria that exclude LD children from special education who supposedly can make progress in regular education classes without special education support. This policy has the effect of eliminating brighter students who are achieving at or close to their grade placements from being considered as LD. Besides these measurement-related issues, there is evidence that LD classification decisions reached by multidisciplinary teams are sometimes based on subjective information rather than empirical data (Coles, 1987; Epps, Ysseldyke, & McGue, 1984; Ysseldyke, Algozzine, Richey, & Graden, 1982). The unreliability of diagnosing children with learning disabilities could result in the erroneous inclusion of ineligible LD children (false positives) and the overlooking of children who are truly LD (false negatives) in the study.

A final limitation involves relying on the use of different psychological and educational instruments, administered by different individuals at different times, and then making psychometric comparisons. This situation was further complicated for retained subjects, where age-normed intelligence test scores were compared with grade-normed achievement test scores in determining LD discrepancies. For these children, it is likely that ability/achievement discrepancies are underrepresented.

CHAPTER IV

RESULTS AND DISCUSSION

Hypothesis 1

The first hypothesis stated that: "The incidence of special education handicaps in all categories was thought to be higher for preterm AGA, full-term SGA,and preterm SGA than the general local population." Table 12 illustrates special education incidence rates by handicap and grades 2 through 8 averages for each of the four intermediate school districts (ISDs) in the mid-Michigan area where 86% (n = 71) of the subjects resided, as well as total area incidence rates. Table 13 notes average grades 2 through 8 incidence rates for the four districts by gender. Tables 14 and 15 compare the individual at-risk groups and pooled special education incidence rates with local population rates. It can be seen that, for five of seven categories, incidence rates were higher by 1.62 to 36.92 times. Only speech and language impairment (SLI) and emotional impairment (EI) rates were roughly similar to the general population (.86 and .80 times the normal incidence). Furthermore, the pooled at-risk group total special education incidence was 2.3 times higher than the local special education population. Because of the limited number of subjects, an average of grade 2 through grade 8 rates was compared, rather than individual grade-by-grade comparisons. In contrast to the hypothesis

Table 12: Intermediate school district special education incidence--Grade 2 through 8 averages.

	Eaton ISD	Clinton ISD	Shiawassee ISD	Ingham ISD
POHI	.0025	.0016	.0021	.0038
HI	.0005	.0007	.0010	.0030
SXI	.0015	.0013	.0007	.0015
EMI	.0057	.0083	.0089	.0075
LD	.0510	.0670	.0380	.0530
SLI	.0230	.0380	.0340	.0260
EI	.0130	.0210	.0160	.0150
Total	.0980	.1390	.1030	.1060

Key: POHI = Physically or otherwise health impaired
HI = Hearing impaired
SXI = Severely multiply impaired
EMI = Educable mentally impaired
LD = Learning disabled
SLI = Speech and language impaired
EI = Emotionally impaired

Table 13: Mid-Michigan ISD special education incidence, by gender.

	Males	Females
POHI	.0011	.0011
HI	.0010	.0011
SXI	.0007	.0008
EMI	.0043	.0034
LD	.0360	.0160
SLI	.0180	.010
EI	.0120	.0036
Total	.0720	.0350

Table 14: Mid-Michigan ISD special education incidence totals--Grades 2 through 8.

	Grade							2 to 8 Ave.
	2	3	4	5	6	7	8	
POHI	.004	.004	.004	.003	.003	.002	.002	.0031
HI	.002	.001	.002	.002	.002	.002	.002	.0019
SXI	.002	.001	.002	.001	.001	.001	.001	.0013
EMI	.007	.006	.008	.008	.008	.006	.009	.0074
LD	.015	.037	.054	.061	.068	.062	.065	.0520
SLI	.044	.049	.043	.029	.017	.008	.006	.0280
EI	.005	.011	.012	.018	.018	.021	.022	.015
Total	.079	.109	.125	.132	.117	.102	.107	.1100

Table 15: PTAGA, PTSGA, FTSGA, and pooled special education rates versus Michigan averages.

	PTAGA Sp.Ed. Incidence	Handicap Ratio (PTAGA to Mich. Ave.)	PTSGA Sp. Ed. Incidence	Handicap Ratio (PTSGA to Mich. Ave.)	FTSGA Sp. Ed. Incidence	Handicap Ratio (FTSGA to Mich. Ave.)
POHI	.095	30.65	.000	0	.000	0
HI	.000	0	.000	0	.071	37.37
SCI	.048	36.92	.038	29.23	.071	54.62
EMI	.000	0	.038	5.14	.000	0
LD	.119	2.29	.077	1.48	.071	1.37
SLI	.000	0	.038	1.36	.071	2.54
EI	.024	1.60	.000	0	.000	0
Total	.286	2.60	.191	1.74	.284	2.58

Table 15: Continued.

	Pooled Rates Versus Michigan Averages		
	Sp. Ed. Incidence	Mid-Michigan Sp. Ed. Incidence	Handicap Ratio (Pooled At-Risk to Mich. Ave.)
POHI	.048	.0031	15.48
HI	.012	.0019	6.32
SCI	.048	.0013	36.92
EMI	.012	.0074	1.62
LD	.097	.0520	1.87
SLI	.024	.0280	.86
EI	.012	.0150	.80
Total	.253	.1100	2.30

that PTAGA and PTSGA groups would have the greatest numbers of special education handicaps, FTSGA subjects had almost the same overall handicap rate (28.4%) as PTAGA infants (28.6%) and more than PTSGA subjects (19.1%). Furthermore, the FTSGA group had special education handicaps in four of seven areas, the same ratio as PTAGA and PTSGA subjects.

Looking at previous reports, premature children were found to have physical or otherwise health impairments (POHI) in the 1% to 8% range. The current study's pooled results were comparable (4.8%). However, no POHI individuals were identified in either the FTSGA or PTSGA groups. As this pattern has not been described or studied by other investigators, it will be interesting to see whether this trend holds true in future long-term studies.

Hearing impairment's (HI) pooled incidence was considerably higher (1.2% versus 0.19%) than local special education rates. Whether the one female FTSGA with a hearing impairment out of the entire sample population represented a chance occurrence or a trend is unknown. It is apparent that this study's limited numbers will not settle this question. In any event, this study's results were less than previous researchers' rates (3% to 4%).

Severe multiple impairments (SXI) were notably higher than local special education rates for all at-risk groupings. As multiple impairment has not been specifically documented in previous studies, the pooled 4.8% rate was 36.92 times higher than local special education rates, and denotes an area of great concern for parents of preterm children and our society in general. Furthermore, SXI rates for all at-risk groups were high (PTSGA = 3.8%, PTAGA = 4.8%, and FTSGA = 7.1%). Previous investigators found 3% to 8% of the premature and low birth weight infants to be only mentally impaired (IQ less than 70). The current study's combined severely multiply impaired and educable mentally impaired (EMI) results (4.8% + 1.2% = 6.0%) were also within that range. However, the four mentally impaired subjects in this study had the additional disadvantage of having one or more serious handicaps (health impairment, physical impairment, visual impairment, and/or hearing impairment). It also should be noted that none of these SXI subjects were included in other special education categories. They were represented only in this one handicap category.

Learning disabilities were also uniformly higher for all groupings of at-risk infants at school age (9.7% at-risk subjects versus 5.2% local special education rates). In comparison to previous studies, the current incidence is nearer to the Lefebvre et al. (1988) lower estimate (8%), but still 1.87 times greater than local population rates.

Only pooled speech and language impairment and emotional impairment rates were lower than the general population. However, PTSGA and FTSGA subjects did have higher rates (1.36 and 2.54 times greater than local population rates) for speech and language impairment. This condition was absent in PTAGA children. Emotional impairment was documented for only one PTAGA child. As emotional impairment was not an outcome studied in prior studies of preterm children, the current results suggest that it is probably not a major outcome for premature or low birth weight infants at school age. The 5% to 17% incidence of speech and language impairments noted by previous studies was not evident in the current results. This higher SLI incidence might be the result of following subjects to only 5 to 7 years of age, a time where higher rates are more likely to be found in the general population.

In summary, it cannot be said that each at-risk group had a higher incidence for every handicap category. When the at-risk groups had representation in an individual handicap category, their rates were much higher than local rates. With the exception of speech and language impairment and emotional impairment, pooled results were larger, on average, for each special education classification area. It was also apparent that each group's total average number of handicaps was considerably greater than the local special education rates.

The second part of the first hypothesis predicted that special education incidence results, by gender, would reflect local special education patterns and that lower SES groups would have higher handicap rates. Table 16 illustrates that gender-related patterns generally follow the local population trends for four of seven categories (EMI, LD, SLI, and EI) with the pooled at-risk groups. Given the small numbers of subjects in this study and the relatively low probability of many of the handicapping conditions, it is inappropriate to imply that the results are representative of the premature and low birth weight population. However, it is interesting that the approximate 3:1 ratio of males having more learning disabilities than females was apparent in the current study, as well as males having slightly higher incidences of emotional impairments, educable mental impairments, and speech and language impairments. At odds with general population patterns, physically or otherwise health impairment and severe multiply impairment rates favored males. Table 16 shows that many of the individual and special education categories were minimally or not represented in the various at-risk groups. Therefore, comparisons were not made. As previous studies have not addressed gender differences for these at-risk groups, it will be interesting to follow future investigations that have larger numbers of subjects.

Regarding SES and special education outcomes, Tables 17 and 18 note an unanticipated set of findings. By SES category, the highest (1) and lowest (5) SES-

Table 16: PTAGA, PTSGA, FTSGA, and pooled special education incidence, by gender.

	PTAGA ($\underline{n}$ = 42)		PTSGA ($\underline{n}$ = 26)		FTSGA ($\underline{n}$ = 14)	
	Male	Female	Male	Female	Male	Female
POHI	3	1	0	0	0	0
HI	0	0	0	0	0	1
SCI	1	1	1	0	1	0
EMI	0	0	1	0	0	0
LD	4	1	2	0	0	1
SLI	0	0	1	0	1	0
EI	1	0	0	0	0	0
Total	9	3	5	0	2	2

	Pooled At-Risk Groups ($\underline{n}$ = 84)			Michigan Incidence by Gender (Grades 2 to 8)	
	Male	Female	Total	Male	Female
POHI	3	1	4	.0011	.0011
HI	0	1	1	.0010	.0011
SCI	3	1	4	.0007	.0008
EMI	1	0	1	.0043	.0034
LD	6	2	8	.0360	.0160
SLI	2	0	2	.0180	.0100
EI	1	0	1	.012	.0036
Total	16	5	21	.0720	.0350

Table 17: PTAGA and PTSGA special education incidence, by SES level.

	PTAGA					PTSGA				
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 1	Level 2	Level 3	Level 4	Level 5
POHI	0	4	0	0	0	0	0	0	0	0
HI	0	0	0	0	0	0	0	0	0	0
SXI	0	1	1	0	0	0	1	0	0	0
EMI	0	0	0	0	0	0	1	0	0	0
LD	0	4	0	1	0	0	0	1	1	0
SLI	0	0	0	0	0	0	0	1	0	0
EI	0	0	1	0	0	0	0	0	0	0
Total	0	9	2	1	0	0	2	2	1	0
Total group	7	22	10	1	2	4	10	6	6	0
SES level % of total	16.7%	52.4%	23.8%	2.4%	0%	15.4%	38.5%	23.1%	23.1%	0%
% of handicaps per SES level	0%	75.0%	16.7%	8.3%	0%	0%	40.0%	40.0%	20.0%	0%

Table 18: FTSGA and pooled special education incidence, by SES level.

	FTSGA					Pooled At-Risk Groups				
	Level 1	Level 2	Level 3	Level 4	Level 5	Level 1	Level 2	Level 3	Level 4	Level 5
POHI	0	0	0	0	0	0	4	0	0	0
HI	0	1	0	0	0	0	1	0	0	0
SXI	0	1	0	0	0	0	3	1	0	0
EMI	0	0	0	0	0	0	1	0	0	0
LD	0	0	0	1	0	0	4	1	2	0
SLI	0	1	0	0	0	0	1	1	0	0
EI	0	0	0	0	0	0	0	1	0	0
Total	0	3	0	1	0	0	14	4	2	0
Total group	1	9	2	2	0	12	41	18	9	0
SES level % of total	7.1%	64.3%	14.3%	14.3%	0%	14.6%	50.0%	21.9%	10.9%	2.4%
% of handicaps per SES level	0%	75.0%	0%	25.0%	0%	0%	70.0%	10.0%	10.0%	10.0%

level groups had underrepresentative rates. The upper-middle SES level (2) had the greatest number of special education handicaps (70% of the total number of handicaps versus 50% of the total number of subjects). Middle and lower-middle SES levels had slightly lower than expected handicap rates (Level 3: 20% versus 21.9%, and Level 4: 10% versus 10.9%) with pooled results. Also, more of the high-incidence handicaps, categories that are generally considered less severe, seemed more likely to occur at middle to lower SES levels. Level 2, conversely, had a broad representation of all of the special education handicapping conditions. Previous research of premature and low birth weight children generally found more handicaps in lower SES-level groupings. In that light, it would be expected that the higher SES-level groups would have less severe handicaps. In the current study, this was found for only the highest SES level (no handicaps in 14.6% of the subject population). The greater than expected upper-middle SES handicap rates would appear to be contrary to previous findings. A possible explanation for these results might be based on the fact that the subjects of this study were primarily from middle to upper SES-level groups, with relatively few low SES subjects involved, and that the study lacked enough subjects to represent all low incidence categories.

Individual at-risk groups showed similar patterns of underrepresenting the highest and lowest SES levels. However, more variability was apparent. PTSGA handicaps were overrepresented at the middle SES level (40% versus 23.1%), with upper-middle and lower-middle-level rates being similar (Level 2: 40% versus 38.5%, and Level 4: 20% versus 23.1%). In contrast, FTSGA rates were variably higher at those levels (Level 2: 75% versus 64.3%, and Level 4: 25% versus 14.3%) and had no handicaps at the middle level. PTAGA results, having the largest number of subjects, reflected the pooled group rates.

In summary, it was difficult to accurately compare the at-risk groups' gender-based patterns of handicaps with local rates due to the limited number of subjects in this study. However, it was evident that pooled at-risk rates were comparable for four of seven special education categories. Regarding the hypothesis that lower SES groups have higher rates of handicaps, pooled group results showed that this was not accurate. For all at-risk groups, the highest and lowest SES levels had no handicaps. The upper-middle SES level had the largest concentration of handicapped subjects using PTAGA, FTSGA, and pooled results. However, it seems likely that the very limited number of lower SES subjects involved in this study contributed to the variability of these findings.

Hypothesis 2

The second hypothesis stated that "Premature and/or low birth weight children were thought to receive more special services, be retained at a higher rate, and be involved with special programs at earlier ages than the general population. Full-term SGA students would be involved with fewer services and programs than preterm SGA and AGA children."

In addition to the previously noted higher incidence of special education handicaps, Table 19 notes the three at-risk groups' involvement with special education and regular education remedial programs. According to the Michigan

Table 19: Special services.

	Number	Percent
PTAGA		
Receiving special education	12	28.6
Receiving remedial programs	6	14.3
Receiving special programs	16	38.1
Not receiving special programs	26	61.9
PTSGA		
Receiving special education	5	19.2
Receiving remedial programs	3	11.5
Receiving special programs	11	42.3
Not receiving special programs	15	57.7
FTSGA		
Receiving special education	4	28.6
Receiving remedial programs	1	7.1
Receiving special programs	6	42.9
Not receiving special programs	8	57.1

Department of Education (personal communication), federally funded remedial programs in reading and math are provided for one in eight to nine students in the state. Each school district defines its own criteria for student eligibility, with more monies and programs being available for lower SES children. Mid-Michigan remedial programs address highly variable needs, and therefore are quite different from one another. With this perspective in mind, the incidence of at-risk subjects involved with remedial programs varied from 7.1% to 14.3%. As predicted, FTSGA subjects (7.1%) received the least amount of additional services. Only PTAGA (14.3%) were more apt to be involved with regular-education-based remedial services than the general population. PTSGA subjects had similar results to the general population incidence rate of 11% to 12.5%. Thus, full-term SGA subjects received fewer regular education special services and programs than the general population. However, all three groups received many more special services, when combining regular education and special education, than did local populations.

Regarding the initial age of special education programming, Table 20 revealed few differences. All the subjects referred for special education evaluations and determined to be eligible for services by IEPCs were identified within the state of Michigan's peak placement ages for each handicap classification. Consequently, it appeared that current Child Find operations implemented by ISDs in the mid-Michigan area identified handicapped children as readily as Sparrow Hospital's RNICU.

Table 20: Average age of special education referral/placement.

Category	Age (Yrs.)	Number	Michigan--Peak Referral Ages
POHI	1.5 yrs.	4	1-2 yrs.
HI	3.0 yrs.	1	3-8 yrs.
SXI	2.3 yrs.	3	1-2 yrs.
EMI	4.0 yrs.	1	3-9 yrs.
LD	6.75 yrs.	8	7-10 yrs.
SLI	4.0 yrs.	5	3-7 yrs.
EI	8.0 yrs.	1	6-15 yrs.

Retentions, illustrated by Table 21, indicated seemingly high rates for at-risk groups identified with special education handicaps PTAGA--58.3%, PTSGA= 100%, FTSGA--50%, and pooled groups--66.7%). Whether these group averages are greater than local or national comparisons is unknown due to the lack of data regarding retention rates for all special education categories. However, these rates did not appear unusual when compared with the Rose et al. (1983) findings for 15, primarily southern, states that retained from 30.5% to over 100% of their students in a 13-year period.

Table 21: PTAGA, PTSGA, FTSGA, and pooled retentions--Special education incidence.

	PTAGA				PTSGA			
	# in Sp. Ed.	Retained (Gender)		% Retained	# in Sp. Ed.	Retained (Gender)		% Retained
		M	F			M	F	
POHI	4	2	0	50%	0	0	0	0%
HI	0	0	0	0%	0	0	0	0%
SXI	2	1	1	100%	1	1	0	100%
EMI	0	0	0	0%	1	1	0	100%
LD	5	2	1	60%	2	2	0	100%
SLI	0	0	0	0%	1	1	0	100%
EI	1	0	0	0%	0	0	0	0%
Total	12	5	2	58.3%	5	5	0	100%

Table 21: Continued.

	FTSGA				Pooled Retentions			
	# in Sp. Ed.	Retained (Gender)		% Retained	# in Sp. Ed.	Retained (Gender)		% Retained
		M	F			M	F	
POHI	0	0	0	0%	4	2	0	50%
HI	1	1	0	100%	1	0	0	0%
SXI	1	1	0	100%	4	3	1	100%
EMI	0	0	0	0%	1	1	0	100%
LD	1	0	0	0%	8	4	1	62.5%
SLI	1	1	0	100%	2	2	0	100%
EI	0	0	0	0%	1	0	0	0%
Total	4	2	0	50%	21	12	2	66.7%

Looking at individual categories, this study found that all of the subjects who were retained had severe multiple impairments, educable mental impairments, and speech and language impairments. Retentions were somewhat less likely for the LD (62.5%) and POHI (50%). No retentions occurred with HI or EI subjects. It should be noted that the HI, EMI, EI, and SLI categories had only one to subjects identified. It is possible that these findings may be chance occurrences rather than population-based trends.

Learning disability retention rates for PTAGA and PTSGA subjects were somewhat higher than rates found by McLeskey and Grizzle (1992) for third-grade LD (54%) and sixth-grade LD (61%) students in Indiana. No FTSGA LD subjects were retained. However, only one individual of the 14 FTSGA subjects had this diagnosis.

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Thus, it appeared that premature and/or low birth weight children had very high retention rates, particularly for children with mental impairments (SXI, EMI). It is not possible to say whether these rates are higher than local and national retention rates for special education students due to the lack of comparative data. Furthermore, LD subjects from PTAGA and PTSGA groups had greater rates of retention than current comparable findings.

For students not involved with special education programs, Tables 22 and 23 show that PTSGA subjects had the highest incidence (38.1%) of retentions, followed by FTSGA (18.2%) and PTAGA (14.3%). This pattern was continued when looking at the total group rates (combining regular education and special education findings). PTSGA had the largest percentage of retained subjects (50%), followed by FTSGA (35.7%) and PTAGA (28.6%). Again, these combined rates are not inconsistent with the findings of Rose et al. (1983).

Where gender-based comparisons were possible, Tables 22 and 23 show that males had a larger percentage of retentions for six of seven SES levels. Differences ranged from a low of 13.7 percentage points for PTAGA, to 20 percentage points for FTSGA subjects, to a high of 53.8 percentage points for PTSGA children.

Interestingly, lower SES seemed to relate to a higher proportion of retentions for pooled group data, as noted in Table 23. SES level 5 could not be included in this trend due to its limited number of subjects (n = 2). Furthermore, this trend was not as consistent when looking at individual at-risk groups. The PTAGA group had

Table 22: PTAGA and PTSGA regular and special education retentions, by SES and gender.

	Level 1		Level 2		Level 3		Level 4		Level 5		Totals		Total %
	M	F	M	F	M	F	M	F	M	F	M	F	
PTAGA Regular education retentions	0	0	2	0	1	2	0	-	0	0	3	2	14.3%
Regular education double retentions	0	0	0	0	0	0	0	-	0	0	0	0	
Special education retentions	-	-	4	1	0	1	1	-	-	-	5	2	
Totals	0	0	6	1	1	3	1	-	0	0	8	4	
Total retained #/SES group	0		31.8%		40.0%		0		28.6%				
M/Tot.M F/Tot.F	0/0		40%/14.3%		33.3%/42.8%		100%/--		0/0		34.8%/21.1%		
Subjects	3	4	15	7	3	7	1	0	1	1	23	19	
PTSGA Regular education retentions	-	2	2	0	1	0	2	1	-	-	5	3	38.1%
Regular education double retentions	-	0	-	-	-	-	1	0	-	-	1	0	
Special education retentions	-	0	2	0	2	0	1	0	-	-	5	0	
Totals	-	2	4	0	3	0	3	1	-	-	10	3	
Total retained #/SES group	50%		40%		50%		50%		--		50%		
M/Tot.M F/Tot.F	-/50%		80%/0		75%/0		75%/50%		--/--		76.9%/23.1%		
Subjects	0	4	5	5	4	2	4	2	0	0	13	13	

Note: Double retentions were not included in totals.

Table 23:

Table 23: FTSGA and pooled regular and special education retentions, by SES and gender.

	Level 1		Level 2		Level 3		Level 4		Level 5		Totals		Total %
	M	F	M	F	M	F	M	F	M	F	M	F	
FTSGA Regular education retentions	-	0	0	0	-	2	-	0	-	-	0	2	18.2%
Regular education double retentions	-	0	0	0	-	0	-	0	-	-	0	0	
Special education retentions	-	0	2	0	-	0	-	1	-	-	2	1	
Totals	-	0	2	0	-	2	-	1	-	-	2	3	
Total retained #/SES group	0		22.2%		100%		50%		--		35.7%		
M/Tot.M F/Tot.F	-/0		50%/0		-/100%		-/100%		-/-		50%/30%		
Subjects	0	1	4	5	0	2	0	2	0	0	4	10	
Pooled Regular & Special Education Retentions Regular education retentions	0	2	4	0	2	4	2	1	0	0	8	7	22.4%
Regular education double retentions	0	0	0	0	0	0	1	0	0	0	1	0	
Special education retentions	0	0	8	1	2	1	2	1	-	-	12	3	
Totals	0	2	12	1	4	5	5	2	0	0	21	10	
Total retained #/SES group	16.7%		31.7%		50%		66.7%		0		37.8%		
M/Tot.M F/Tot.F	0/22.2%		50%/5.9%		57.1%/45.5%		80%/50%		0/0		51.2%/24.4%		
Subjects	4	9	24	17	7	11	5	4	1	1	41	41	

Note: Double retentions were not included in totals.

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larger proportions for each lower SES level, with the exception of level 5. PTSGA subjects had roughly equivalent results across all levels. And the FTSGA group had higher rates for levels 1 through 3, and lower rates at levels 3 and 4. It is also possible to interpret the overall trend as evident for PTAGA subjects only, noting its greater number of subjects overwhelmed the lower numbers of subjects in the other groups.

Whether this tendency for males to be retained more than females, and for lower SES levels to be retained at proportionally higher rates, is evident in the general population is unknown at present.

Hypothesis 3

Before testing the third set of hypotheses, it will be useful to examine the test results of all subjects in the three at-risk groups. Tables 24, 25, and 26 present their test means, medians, and standard deviations. Looking at the three groups' results, test means generally ranged from the lower limits of the average range to average (IQ scores of 90 to 109 are considered as average). IQ test scores typically increased from 2 years of age onwards to more recent assessments at approximately 8 years of age or older. Median test scores for all groups were higher than mean results.

When comparing means, it is of interest to note the tendency for the PTAGA test scores all to be higher than PTSGA and FTSGA results, and all FTSGA results to be lower than PTSGA scores. The previous literature review (Table 6) showed that PTSGA children had a 6.4 IQ point disadvantage when compared to PTAGA children at school age. The PTAGA 4.17 IQ point disparity from average (100) appears to substantiate previous comparative studies. However, the previously noted PTSGA 9.6 IQ point advantage (Table 5) over FTSGA children was not apparent in the current study. The 3.36 IQ point FTSGA advantage may be due to the low number of subjects (n = 14) for this group.

Table 24: PTSGA test data (entire sample).

	Mean	Median	SD	PTAGA Diff.	FTSGA Diff.
IQ (CA: 6-7 yrs.)	93.90	99.00	23.06	-5.10	9.90
IQ (CA: 4-5 yrs.)	91.87	96.00	26.82	-7.54	-4.35
IQ (CA: 2-3 yrs.)	89.87	95.00	25.63	-8.06	4.45
Most recent IQ	94.50	100.00	24.74	-4.17	3.36
Total reading	97.48	103.00	24.52	- .35	6.41
Reading recognition	96.40	100.00	22.58	-2.86	3.63
Reading comprehension	98.68	105.00	25.87	- .67	7.18
Spelling/wr. language	93.92	99.00	23.39	- .74	5.74
Math computation	96.44	101.00	23.65	-3.63	3.29
Math applications	97.81	103.00	28.10	-6.80	4.39
Total math	98.32	104.00	25.03	-2.96	2.68

Table 25: FTSGA test data (entire sample).

	Mean	Median	SD	PTAGA Diff.
IQ (CA: 6-7 yrs.)	84.00	91.00	30.10	-15.00
IQ (CA: 4-5 yrs.)	96.22	100.00	11.30	- 3.19
IQ (CA: 2-3 yrs.)	85.42	93.00	27.86	-12.51
Most recent IQ	91.14	96.50	25.38	- 7.53
Total reading	91.07	93.00	26.74	- 6.76
Reading recognition	92.77	96.00	29.02	- 6.49
Reading comprehension	91.50	94.00	28.86	- 7.85
Spelling/wr. language	88.18	87.00	30.19	- 6.48
Math computation	93.15	100.00	29.72	- 6.92
Math applications	93.42	97.50	30.58	-10.69
Total math	95.64	99.00	29.88	- 5.64

Table 26: PTAGA test data (entire sample).

	Mean	Median	SD
IQ (CA: 6-7 yrs.)	99.00	102	16.70
IQ (CA: 4-5 yrs.)	99.41	99	17.59
IQ (CA: 2-3 yrs.)	97.93	100	14.47
Most recent IQ	98.67	100	17.06
Total reading	97.83	101	20.54
Reading recognition	99.26	102	100.58
Reading comprehension	99.35	103	20.05
Spelling/wr. language	94.66	94	20.62
Math computation	100.07	101	21.01
Math applications	104.11	105	19.36
Total math	101.28	101	20.75

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Achievement test score patterns for the three at-risk groups followed the IQ pattern and, interestingly, were consistent across all tested areas. PTAGA differences from PTSGA scores ranged from a .35 point low (Total Reading) to a 6.3 point high (Math Applications/Concepts). Whether this pattern will continue in future studies will be of interest as no information is currently available. Greater achievement score differences were evident between FTSGA and PTSGA groups (ranging from 2.68 to 7.18 points). Again, prior studies have not investigated academic achievement differences between FTSGA and PTSGA children at school age. Therefore, no comparisons could be made.

The third hypothesis postulated that "there would be a greater proportion of psychometrically identified LD students using both regression analysis and standard score discrepancy methods in determining a significant discrepancy between IQ and academic achievement for preterm AGA and SGA students than IEPC identifies students." The data in Table 27 show that this hypothesis was accurate for all at-risk groups using both regression analysis and standard score models and employing 2%, 5%, and 6.5% cutting scores. FTSGA (7.1%), PTSGA (7.7%), and PTSGA (11.6%) IEPC identified LD rates were comparable to the lower rates found by Lefebvre et al. (1988). In contrast, the psychometrically determined rates were similar to the higher incidences (23.3%) noted by Sell et al. (1985). Little variability was found between total numbers identified at each cutting score for standard score versus regression analysis methods. Likewise, when looking at total numbers of LD areas by either method, Tables 28, 29, and 30 indicate few differences. Tables 28

and 30 also show that only five of the seven IEPC identified LD students met the psychometric eligibility criteria of both methods. With the exception of one individual, the five IEPC identified LD students were eligible with both methods at the most severe cutting score levels.

Table 27: Total sample LD discrepancies.

	Std. Score Discrep.	n	%	Regr. Anal.	n	%	IEPC LD	n	%
PTSGA	18 20 24	6 6 3	23.1 23.1 11.5	18 20 24	6 6 4	23.1 23.1 15.4		2	7.7
FTSGA	18 20 24	4 4 2	28.6 28.6 14.3	18 20 24	4 3 2	28.6 21.4 14.3		1	7.1
PTAGA	18 20 24	10 10 8	23.3 23.3 18.6	18 20 24	10 8 7	23.3 18.6 16.3		5	11.6

Table 28: PTSGA--Total sample LD discrepancies.

Standard Score Point Discrepancy	Standard Score Discrepancy	Regression Analysis Discrepancy
18 points	16 discrepant areas 2.67 areas per subject 6 LD subjects	14 discrepant areas 2.33 areas per subject 6 LD subjects
20 points	16 discrepant areas 2.67 areas per subject 6 LD subjects	14 discrepant areas 2.33 areas per subject 6 LD subjects
24 points	8 discrepant areas 2.67 areas per subject 3 LD subjects	10 discrepant areas 2.5 areas per subject 4 LD subjects

Table 29: FTSGA--Total sample LD discrepancies.

Standard Score Point Discrepancy	Standard Score Discrepancy	Regression Analysis Discrepancy
18 points	12 discrepant areas 3.0 areas per subject 4 LD subjects	10 discrepant areas 2.5 areas per subject 4 LD subjects
20 points	6 discrepant areas 1.5 areas per subject 4 LD subjects	8 discrepant areas 2.67 areas per subject 3 LD subjects
24 points	3 discrepant areas 1.5 areas per subject 2 LD subjects	2 discrepant areas 1.0 areas per subject 2 LD subjects

Table 30: PTAGA--Total sample LD discrepancies.

Standard Score Point Discrepancy	Standard Score Discrepancy	Regression Analysis Discrepancy
18 points	27 discrepant areas 2.7 areas per subject 10 LD subjects	28 discrepant areas 2.8 areas per subject 10 LD subjects
20 points	23 discrepant areas 2.3 areas per subject 10 LD subjects	24 discrepant areas 3.0 areas per subject 8 LD subjects
24 points	11 discrepant areas 1.375 areas per subject 8 LD subjects	18 discrepant areas 2.57 areas per subject 7 LD subjects

Whether the large differences between psychometric and IEPC identified LD rates were based on the relatively lower reliability of group tests versus individually administered tests, or other factors was difficult to determine. If one assumes that the results are accurate estimates, these differences in rates would cause the prudent special educator to reflect on the adequacy of current referral practices.

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Also, the failure of the psychometric methods to identify all IEPC identified LD students provided some support of the contention by Ross (1992), Coles (1987), Ysseldyke and McGue (1984), and Ysseldyke et al. (1982) that LD classification decisions are sometimes based on subjective information rather than empirical data. Conversely, this study's results also provide support for the argument that many students having empirically based ability/achievement discrepancies also are not identified by special education practices as learning disabled.

The second part of this hypothesis was "that matched PTSGA IQ and achievement test means would be significantly lower than matched PTAGA results." This pattern was postulated to continue with PTAGA test results being higher than matched FTSGA scores." Tables 31 and 32 illustrate matched groups' means, standard deviations, and two-sample t-test relationships. PTSGA and PTAGA subjects (Table 31) matched on the basis of gender, date of birth, gestational age, and SES had no significant differences in any of the areas compared. FTSGA and PTAGA subjects (Table 32) matched on gender, birth weight, and date of birth also had no significant differences.

Although PTSGA children had generally lower test results than PTAGA children for all categories, with the exception of SES and Reading Comprehension, significant differences at the $p = .05$ level were not apparent. This study's IQ results confirmed the Robertson et al. (1990) and Drillien (1970) results but were inconsistent with other studies and the previously noted overall 6.4 IQ point PTSGA disadvantage. The PTSGA IQ difference of 2.05 points was less than the previous

Table 31: Matched PTSGA/PTAGA test data.

	t	p	DF	Signif.
Gestational age	-0.03	.98	39	NS
SES	.65	.52	.39	NS
IQ	-0.30	.77	37	NS
Reading Total	-0.03	.98	39	NS
Reading Recognition	-0.29	.77	39	NS
Reading Comprehension	0.44	.66	33	NS
Spelling/Written Lang.	-0.49	.63	37	NS
Math Computation	-0.34	.73	35	NS
Math Applic./Concepts	-0.72	.48	31	NS
Math Total	-0.55	.58	39	NS

	PTSGA		PTAGA		SGA Diff.
	Mean	SD	Mean	SD	
Gestational age	33.955	2.919	34.023	2.528	- .068
Last IQ	96.620	24.830	98.670	19.111	-2.05
SES Level	2.600	0.995	2.429	0.926	+ .17
Reading Total	97.900	24.890	98.140	27.580	- .24
Reading Recog.	96.000	23.500	98.240	26.710	-2.24
Reading Comp.	100.220	25.900	96.220	28.300	+4.00
Spelling/Written Lang.	93.710	24.380	97.800	28.890	-4.09
Math Computation	96.330	23.550	99.300	31.310	-2.97
Math Applic./ Concepts	98.180	28.630	105.470	30.070	-7.29
Math Total	98.480	25.040	103.050	28.520	-4.57

Table 32: Matched FTSGA/PTAGA test data.

	t	p	DF	Signif.
Birthweight	0.05	.96	19	NS
SES	0.00	1.00	18	NS
IQ	-0.89	.39	14	NS
Reading Total	-1.07	.30	17	NS
Reading Recognition	-0.89	.39	14	NS
Reading Comprehension	-1.13	.28	11	NS
Spelling/Written Lang.	-1.22	.25	9	NS
Math Computation	-1.17	.26	15	NS
Math Applic./Concepts	-1.36	.20	10	NS
Math Total	-0.86	.41	15	NS

	PTSGA		PTAGA		SGA Diff.
	Mean	SD	Mean	SD	
Birthweight	2216	398	2208	466	- 8.00
SES	2.364	0.674	2.364	0.505	0
IQ	92.09	28.66	100.55	13.23	- 8.46
Reading Total	90.00	20.91	98.27	14.66	- 8.27
Reading Recog.	92.30	24.99	100.45	15.48	- 8.15
Reading Comp.	90.78	22.64	100.20	11.44	- 9.42
Spelling/Written Lang.	86.25	24.42	97.89	12.10	-11.64
Math Computation	92.30	22.42	102.18	15.09	- 9.88
Math Applic./ Concepts	91.89	24.51	103.91	11.18	-12.02
Math Total	95.00	23.72	102.00	13.10	- 7.00

findings. For academic achievement, PTSGA test results ranged from 0.24 to 7.29 standard score points lower, with only one exception (Reading Comprehension, +4.0).

FTSGA subjects had lower test results than PTAGA children in all categories. However, significant differences at the $p = .05$ level were not evident. In contrast to the Drillien (1970) follow-up study, these results noted lower FTSGA IQ scores. An 8.46 IQ point disadvantage was evident, versus the previously noted 9.6 FTSGA advantage over PTAGA children. Academic achievement differences ranged from -7.0 to -12.02 standard score points.

Thus, the second part of the third hypothesis predicting significant differences between matched groups of PTSGA and PTAGA children, and between matched FTSGA and PTAGA subjects, was not supported.

Regarding ability/achievement discrepancies, Tables 33 and 34 illustrate that there were more PTSGA subjects with a greater number of psychometrically identified achievement/ability discrepancies than PTAGA matches, using both standard score and regression analysis methods at all (6.5%, 5%, and 2% cutting scores) levels. However, it should be recognized that these differences were based only on descriptive statistics. Larger numbers of subjects using random design methods would be needed to better determine the statistical significance of these findings. These results were also somewhat different from the total sample rates (Table 27), with the matched group PTSGA subjects having approximately 4% more LD discrepancies using the standard score method across all cutting scores. Total sample results at all cutting scores were generally equivalent, except for the most severe level, where there was a 7% difference. Regression analysis matched-group comparisons (Table 34) revealed greater LD rates for PTSGA children at all discrepancy levels (differences ranging from 9.1% to 13.6%). However, the group of matched PTAGA subjects (Table 34) had fewer LD discrepancies than the total sample rates (Table 27).

Table 33: Matched PTSGA/PTAGA LD discrepancies--Standard score method.

Standard Score Point Discrepancy	PTSGA	PTAGA Matches
18 points	16 discrepant areas 2.66 areas per subject 6 LD subjects (27.3%)	16 discrepant areas 3.2 areas per subject 5 LD subjects (22.7%)
20 points	12 discrepant areas 2.4 areas per subject 5 LD subjects (22.7%)	9 discrepant areas 2.25 areas per subject 4 LD subjects (18.2%)
24 points	9 discrepant areas 2.24 areas per subject 4 LD subjects (18.2%)	4 discrepant areas 1.33 areas per subject 3 LD subjects (13.6%)

Table 34: Matched PTSGA/PTAGA LD discrepancies--Regression analysis method.

Standard Score Point Discrepancy	PTSGA	PTAGA Matches
18 points	12 discrepant areas 2.4 areas per subject 5 LD subjects (22.7%)	6 discrepant areas 2.0 areas per subject 3 LD subjects (13.6%)
20 points	12 discrepant areas 2.4 areas per subject 5 LD subjects (22.7%)	4 discrepant areas 2.0 areas per subject 2 LD subjects (9.1%)
24 points	9 discrepant areas 2.25 areas per subject 4 LD subjects (18.2%)	4 discrepant areas 2.0 areas per subject 2 LD subjects (9.1%)

The numbers of matched FTSGA LD discrepancies were much larger than PTAGA matches (Tables 35 and 36) using both standard score and regression methods. The regression analysis method noted larger differences than standard score differences (27.3% to 9.1% versus 18.2% to 0%) at the different discrepancy levels. Although it appeared that PTSGA and FTSGA subjects were more apt to have LD discrepancies than matched PTAGA children, the small number (n = 11) of pairings limits the significance of these findings. Also, the previously noted results in Table 27, using larger numbers of subjects, seemed to contradict these results.

Determining whether PTSGA and FTSGA children have more extensive ability/achievement discrepancies than PTAGA matches, Tables 33/34 and 35/36 show findings comparing per student LD area rates for these groups using both standard score and regression analysis methods. Tables 33 and 34 revealed little variation between matched PTSGA and PTAGA groups. For standard score discrepancy methods, averages differed only by as much as .92 area per child. Regression analysis methods noted even smaller differences (up to .4 LD area per student). FTSGA comparisons were similar, with standard score methods noting an increase of one LD area for only one of the three discrepancy levels. Regression analysis noted an increase of one LD area per student for 18- and 20-point discrepancies. There was no difference between groups at the 24-point level. Therefore, it appears that LD discrepancies are not more extensive for PTSGA and FTSGA children than for PTAGA pairings.

Table 35: Matched FTSGA/PTAGA LD discrepancies--Standard score method.

Standard Score Point Discrepancy	FTSGA	PTAGA Matches
18 points	10 discrepant areas 2.5 areas per subject 4 LD subjects (36.4%)	5 discrepant areas 2.5 areas per subject 2 LD subjects (18.2%)
20 points	6 discrepant areas 1.5 areas per subject 4 LD subjects (36.4%)	3 discrepant areas 1.5 areas per subject 2 LD subjects (18.2%)
24 points	2 discrepant areas 1.0 area per subject 1 LD subject (9.1%)	2 discrepant areas 2.0 areas per subject 1 LD subject (9.1%)

Table 36: Matched FTSGA/PTAGA LD discrepancies--Regression analysis method.

Standard Score Point Discrepancy	FTSGA	PTAGA Matches
18 points	8 discrepant areas 2.0 areas per subject 4 LD subjects (36.4%)	1 discrepant area 1.0 areas per subject 1 LD subject (9.1%)
20 points	6 discrepant areas 2.0 areas per subject 3 LD subjects (27.3%)	1 discrepant area 1.0 areas per subject 1 LD subject (9.1%)
24 points	2 discrepant areas 1.0 area per subject 2 LD subjects (18.2%)	1 discrepant area 1.0 area per subject 1 LD subject (9.1%)

Hypothesis 4

The fourth hypothesis stated that "there would be more psychometrically identified learning disabilities with lower SES children . . . than matched groups of higher SES children." Before addressing this hypothesis, it should be noted that the eight pairs of lower versus higher SES subjects were selected from the three at-risk groups. Only PTSGA subjects were matched with other PTSGA children. This principle was used for the other two at-risk groups as well. Further matching criteria included gestational age, gender, and date of birth for PTSGA and PTAGA pairs; and gender, birth weight, and date of birth for FTSGA pairs. Because of the limited numbers of lower SES subjects, it was not possible to compare at-risk groups, as intended in the original research proposal. SES pairings involved matching level 4 or 5 subjects with level 1 or 2 children. The combined group included three PTAGA pairs, two FTSGA pairs, and three PTSGA pairs. Table 37 illustrates test means, standard deviations, and two-sample t-test results. As noted, the lower SES group had significantly lower results ($p = .025$) for four of the eight tests (Reading Recognition, Reading Comprehension, Spelling/Written Language, and Math Computation). Likewise, slightly lower-level relationships ($p = .05$) were apparent for Reading Totals, Math Application/Concepts, and Math Totals. Interestingly, the only results that were not significantly different involved IQ scores. As noted in previous studies, higher SES level subjects with at-risk backgrounds had significantly higher IQ scores than similar subjects from lower SES families. Thus, the hypothesis that lower SES children would have lower ability and achievement test scores was accurate for four of eight achievement tests only.

Regarding psychometrically identified rates of learning disabilities, Table 38 points out that the lower SES group had more LD subjects at all discrepancy levels

Table 37: Higher versus lower SES test data--t-tests.

	Low SES		High SES		Low SES Diff.
	Mean	SD	Mean	SD	
Last IQ	98.38	15.42	101.12	15.46	- 2.74
Reading Total	99.75	18.06	113.88	18.61	-14.13
Reading Recognition	95.75	16.74	115.29	11.34	-19.54
Reading Comprehension	102.43	15.59	119.43	8.87	-17.00
Spelling/Written Lang.	95.00	20.70	114.14	10.51	-19.14
Math Computation	93.13	25.05	114.71	9.52	-21.58
Math Applic./Concepts	101.86	19.11	112.86	7.20	-11.00
Math Total	97.00	20.65	111.00	17.13	-14.00
SES	4.250	0.463	1.625	0.518	+ 2.625

	t	p	df	Signif.
Last IQ	-0.36	0.730	13	NS
Reading Total	-1.54	0.150	13	NS
Reading Recognition	-2.67	0.020	12	.975+
Reading Comprehension	-2.51	0.033	9	.975+
Spelling/Written Lang.	-2.30	0.044	10	.975+
Math Computation	-2.26	0.050	9	.975+
Math Applic./Concepts	-1.43	0.200	7	NS
Math Total	-1.48	0.160	13	NS
SES	10.69	0.000	13	.9995+

Table 38: Higher versus lower SES LD discrepancies.

Standard Score Point Discrepancy	Standard Score Discrepancy	
	Low SES	High SES
18 points	9 discrepant areas 3.0 areas per subject 3 LD subjects (37.5%)	2 discrepant areas 2.0 areas per subject 1 LD subject (12.5%)
20 points	8 discrepant areas 2.67 areas per subject 3 LD subjects (37.5%)	2 discrepant areas 2.0 areas per subject 1 LD subject (12.5%)
24 points	7 discrepant areas 3.5 areas per subject 2 LD subjects (25%)	0 discrepant areas 0 areas per subject 0 LD subjects

Standard Score Point Discrepancy	Regression Analysis Discrepancy	
	Low SES	High SES
18 points	7 discrepant areas 2.33 areas per subject 3 LD subjects (37.5%)	2 discrepant areas 2.0 areas per subject 1 LD subject (12.5%)
20 points	6 discrepant areas 2.0 areas per subject 3 LD subjects (37.5%)	2 discrepant areas 2.0 areas per subject 1 LD subject (12.5%)
24 points	4 discrepant areas 2.0 areas per subject 2 LD subjects (25%)	1 discrepant area 1.0 areas per subject 1 LD subjects (12.5%)

of both standard score and regression analysis models. However, the low numbers of subjects involved in this question limit the confidence one can have about its implications. In any event, these results provide some support for the U.S. Department of Education (1992) analysis of special education populations, which viewed the higher LD incidence of African Americans as evidence of low SES groups being more apt to have learning disabilities. These results, with some reservation, support the hypothesis that lower SES children will have a greater number of and more severe learning disabilities than groups of similar higher SES subjects.

Lower SES subjects also tended to have slightly more extensive LD discrepancies. The mean rates of LD areas were larger for all standard score levels (from 1.0 to 3.5 more areas per LD subject). Regression-analysis-based rates for learning disabilities were larger in two of three levels for lower SES children.

Thus, it is apparent that this study's data supported all aspects of the fourth hypothesis. However, it is important to view these results and any ensuing conclusions with caution due to the low numbers of subjects involved.

Hypothesis 5

The first part of the fifth hypothesis stated that "there would be significant differences between at-risk LD subjects identified by IEPCs and a matched group of local LD students with normal neonatal backgrounds. It was thought that at-risk children would have significantly lower ability and achievement tests. . . ." Table 39 illustrates group means, standard deviations, and two-sample *t*-test results for the eight pairs of subjects' WISC-R scores. It was apparent that both groups had scores between the lower limits of the average to the upper limits of the low average range of intelligence. As noted previously, students typically scoring within this range of cognitive abilities tend to be at a disadvantage in being identified as LD using standard score discrepancy methods. Significant differences were evident between

Table 39: At-risk LD versus local LD WISC-R t-test comparisons.

	At-Risk/LD		LD/Match		t	p	df	Signif.
	Mean	SD	Mean	SD				
Verbal IQ	87.37	5.83	86.13	11.58	0.27	0.79	10	NS
Performance IQ	91.88	10.41	95.87	9.85	-0.79	0.44	13	NS
Full Scale IQ	88.75	7.09	90.75	6.50	-0.59	0.57	13	NS
Verbal Subtests								
Information	7.375	2.264	7.000	2.204	0.34	0.74	13	NS
Similarities	9.000	2.673	8.120	3.040	0.61	0.55	13	NS
Arithmetic	7.250	1.488	6.625	1.302	0.89	0.39	13	NS
Vocabulary	7.625	2.446	8.625	1.847	-0.92	0.37	13	NS
Comprehension	8.250	1.909	8.750	2.493	-0.45	0.66	13	NS
Digit Span	8.400	3.510	6.875	2.588	0.84	0.43	6	NS
Performance Subtests								
Picture Completion	8.625	2.669	9.500	2.777	-0.64	0.530	13	NS
Picture Arrangement	10.750	3.060	11.000	1.852	-0.20	0.850	11	NS
Block Design	6.625	2.446	9.625	2.774	-2.29	0.039	13	.975+
Object Assembly	9.120	3.000	9.125	1.885	0.00	1.000	11	NS
Coding	9.500	1.927	8.125	2.696	1.17	0.260	12	NS

the matched groups for only one area, the Block Design subtest in the performance ability tests ($p = .039$). Sattler (1988) described this subtest as being associated with the following factors: nonverbal reasoning, perceptual organization, perceptual reproduction, perceptual synthesis, perception of abstract stimuli, psychomotor speed, spatial perception, visual-motor coordination, and working under time pressure. As noted previously, little information was available concerning test profiles or patterns distinguishing neonatal-based learning disabilities. For this one significant subtest of the WISC-R to be considered a reliable factor in determining a neonatal-based learning disability, larger and more empirically controlled samples need to be pursued. Thus, there is some question whether this one significant difference is a valid factor distinguishing between the at-risk subjects and children who do not have similar neonatal backgrounds.

Table 40 notes that, for both groups, only five of eight LD subjects had an 18-point standard score discrepancy with the standard score discrepancy method. When using regression analysis, seven of eight LD subjects had an 19 standard score point discrepancy. Thus, it appeared that some of this study's IEPC identified LD subjects lacked empirical data to support their eligibility determinations, even when using the most lenient criteria. This false negative situation as well as the difference between LD discrepancy methods needs to be taken into account when interpreting the significance of the Block Design variable.

Regarding academic achievement test results, Table 41 shows that there were no significant differences between at-risk and local LD groups. Only tests of reading comprehension approached the level of statistical significance ($p = .14$). As this question has not been addressed in previous research, it will be interesting to note whether these results are found in future studies.

Consequently, it appears that there was little statistical support for the first part of this hypothesis. Furthermore, the one area of significant difference (Block Design) was questionable, based on some comparison-group members lacking an empirical ability/achievement discrepancy and the small numbers of the study.

Table 40: Psychometric ability/achievement discrepancies in IEPC identified LD subjects.

Standard Score Point Discrepancy	Standard Score Discrepancy	
	At-Risk LD	Local LD
18 points	13 discrepant areas 2.6 areas per subject 5 LD subjects (62.5%)	13 discrepant areas 2.6 areas per subject 5 LD subjects (62.5%)
20 points	12 discrepant areas 2.4 areas per subject 5 LD subjects (62.5%)	12 discrepant areas 2.4 areas per subject 5 LD subjects (62.5%)
24 points	5 discrepant areas 2.5 areas per subject 2 LD subjects (25%)	9 discrepant areas 1.8 areas per subject 5 LD subjects (62.5%)

Standard Score Point Discrepancy	Regression Analysis Discrepancy	
	At-Risk LD	Local LD
18 points	17 discrepant areas 2.43 areas per subject 7 LD subjects (87.5%)	17 discrepant areas 2.43 areas per subject 7 LD subjects (87.5%)
20 points	16 discrepant areas 2.67 areas per subject 6 LD subjects (75%)	13 discrepant areas 2.6 areas per subject 5 LD subjects (62.5%)
24 points	12 discrepant areas 2.4 areas per subject 5 LD subjects (62.5%)	11 discrepant areas 2.2 areas per subject 5 LD subjects (62.5%)

Table 41: At-risk LD versus local LD achievement t-test comparisons.

	At-Risk/LD		LD/Match		t	p	df	Signif.
	Mean	SD	Mean	SD				
Reading Recognition	74.25	8.18	72.50	10.05	0.30	0.77	7	NS
Reading Comprehension	66.33	5.13	78.00	13.38	-1.75	0.14	5	NS
Reading Total	74.00	9.10	74.67	10.05	-0.13	0.90	10	NS
Written Language	75.70	6.45	72.25	7.96	0.97	0.35	13	NS
Math Calculation	79.75	4.53	79.25	12.94	0.10	0.92	8	NS
Math Reasoning	90.00	NA	93.00	11.31	0.00	1.00	14	NS
SES	2.875	.991	3.125	0.641	-0.60	0.56	11	NS

The second part of this hypothesis predicted that at-risk LD subjects would have "more severe ability/achievement discrepancies, and greater numbers of academic discrepancies" than local LD children. The data in Table 40 indicated that this part of the hypothesis was not supported. Using regression analysis methodology, both groups essentially had identical numbers of discrepancies at all levels, and had similar rates of average discrepancy areas per individual at each cutting score. Given the lower ability test scores of the comparison groups, it is thought that regression analysis methods perhaps provided the most fair means of comparing the number and severity of LD discrepancies. Standard score methods also noted equivocal results at the 18- and 20-point discrepancy levels, but identified more local LD discrepancies at the 24-point level. However, at-risk subjects had slightly more ability/achievement area discrepancies at the 24-point standard score level (2.5 versus 1.8).

Thus, the second part of this hypothesis was not supported.

Hypothesis 6

The sixth hypothesis stated that "prenatal and perinatal factors would be significantly related to learning disabilities for both psychometrically and IEPC identified LD subjects." Table 42 illustrates Pearson product moment correlations for 27 variables possibly associated with IEPC identified LD subjects, as well as for LD subjects using standard score and regression analysis discrepancy models at three cutting scores (6.5%, 5%, and 2%).

Table 42: LD correlations.

Variable	IEPC LD	SSLD 18	SSLD 20	SSLD 24	RLD 18	RLD 20	RLD 24
Gender	-0.164	-0.284	-0.284	-0.194	-0.284	-0.211	-0.276
Marital Status	0.100	0.072	0.072	0.023	0.072	0.049	0.003
Mother's Education	-0.326	-0.022	-0.022	-0.046	0.005	-0.004	-0.057
Father's Education	-0.062	0.108	0.108	0.114	0.000	-0.033	0.085
Mother's Occupation	-0.083	-0.067	-0.067	-0.028	0.029	-0.022	-0.084
Father's Occupation	0.022	0.085	0.085	0.031	0.018	-0.074	0.024
Birth Order	-0.105	0.051	0.051	-0.065	0.051	-0.003	-0.132
Total in Family	-0.139	0.030	0.030	-0.126	0.011	-0.012	-0.152
Birthweight	-0.084	-0.100	-0.100	-0.230	-0.135	-0.229	-0.198
Gestational Age	-0.009	-0.006	-0.006	-0.184	-0.029	-0.092	-0.106
AGA/SGA	-0.074	0.014	0.014	-0.054	0.014	0.043	0.010
# Otitis Media	-0.173	0.061	0.061	-0.053	0.121	0.103	-0.010

Table 42: Continued.

Variable	IEPC LD	SSLD 18	SSLD 20	SSLD 24	RLD 18	RLD 20	RLD 24
RDS	-0.110	-0.190	-0.190	-0.015	-0.190	-0.139	-0.066
ICU Time (days)	-0.056	0.017	0.017	0.131	0.098	0.169	0.127
Ventilator Time (days)	-0.033	0.044	0.044	0.136	0.074	0.105	0.162
IUS Status	-0.118	-0.052	-0.052	-0.076	0.024	0.058	-0.056
Seizure Status	-0.129	0.110	0.110	0.012	0.193	0.240	0.141
Meconium Status	-0.020	0.167	0.167	-0.004	0.167	0.044	0.121
Race	-0.100	0.030	0.030	0.093	0.131	0.167	0.120
PT/FT	-0.040	0.044	0.044	-0.120	0.044	0.008	-0.004
SES Level	0.177	0.051	0.051	0.065	0.111	0.152	0.095
Birthweight x GA	-0.086	-0.072	-0.072	-0.230	-0.103	-0.202	-0.178
Birthweight x PT/FT	-0.079	-0.015	-0.015	-0.209	-0.033	-0.118	-0.103
Birthweight x AGA/SGA	-0.074	0.022	0.022	-0.111	0.051	0.043	-0.002
SES x GA	0.179	0.053	0.053	0.020	0.093	0.118	0.061
SES x AGA/SGA	0.039	0.038	0.038	-0.044	0.058	0.096	0.037
SES x Birthweight	0.094	-0.016	-0.016	-0.064	-0.015	-0.035	-0.046

Regarding IEPC LD subjects, 11 variables had correlations between ± 0.100 and ± 0.179, all relatively low. The only variable having a higher level of correlation (-0.326) involved lower levels of mothers' education relating to the increased likelihood of their children being identified as LD by an IEPC. Multiple regression analysis was used to determine which variables best predicted IEPC identified LD subjects. Beginning with those variables having a ± 0.100 correlation, and then locating variables with $\underline{p}$ values of less than ±.2 in a 24-variable multiple regression equation, the "best line of fit" was obtained. Table 43's regression equation notes two variables with p-values equal to or less than .05, and significantly related to IEPC identified learning disabilities. Lower maternal educational levels and smaller family sizes accounted for 16% of the criterion variance. This regression equation was significant at the $p = .001$ level (Table 43).

Table 43: IEPC LD subjects/regression analysis. The regression equation is LD = 1.87 - 0.113 (mother's education) - 0.0487 (total in family).

Predictor	Coef.	SD	t-Ratio	p
Constant	1.87400	0.20420	9.18	.000
C3 (Mother's education)	-0.11277	0.03095	-3.64	.000
C8 (Total in family)	-0.04868	0.02156	-2.26	.027

s = 0.2770 R-Square = 16.0% R-Square (adj) = 13.9%

Analysis of Variance:

Source	df	SS	MS	F	p
Regression	2	1.15807	0.57904	7.55	.001
Error	79	6.06144	0.07673		
Total	81	7.21951			

In contrast to previous studies, these specific factors have not been associated with learning disabilities. Larger families were more likely to be associated with learning disabilities according to Rutter and Yule (1972). Lower level of maternal education was related to lower level reading skills (Davie et al., 1972), but not learning disabilities. Because no prenatal or perinatal factors were found to be significant, it is apparent that the sixth hypothesis was not confirmed for IEPC identified LD subjects.

Looking at psychometrically identified LD subjects using a standard score discrepancy model yielded equivocal correlational results at the 18- and 20-=point difference levels (see Table 42). The data in Tables 44 and 45 depicted similar equivalent results with multiple regression analysis. Five variables in Table 42 had correlations between ± 0.100 and ± 0.190. Only one variable had a higher correlation (-0.284). It found that males were more likely to have a learning disability. This same variable was the only one found using multiple regression analysis. It accounted for 8.1% of the criterion's variance, with a significance level of p = .01. The higher correlation of males with learning disabilities is well documented in LD literature, with LD males generally outnumbering LD females by 3 to 1. Overall, these findings did not support the sixth hypothesis.

At the most severe level (24 points or more ability/achievement discrepancy), 11 variables had correlations ranging from ± 0.100 to ± 0.230. Of these largest and smallest correlations, lower birth weights (-0.230), being male (-0.194), having shorter gestational ages (-0.184), the interaction of low birth weights and shorter gestational ages (-0.230), and the interaction of lower birth weights and being preterm versus full-term (-0.209) had the largest correlations. Regression analysis (Table 46) showed only two factors reached significant levels (p < .05): being male, and the interaction of lower birth weights and shorter gestational ages. However, the

Table 44: Standard score method--18-point discrepancy/regression analysis. The regression equation is LD = 0.366 - 0.244 (gender).

Predictor	Coef.	SD	t-Ratio	p
Constant	0.36585	0.06510	5.62	.000
C1 (Gender)	-0.24390	0.09207	-2.65	.010

s = 0.4169 R-Square = 8.1 R-Square (adj) = 6 .9%

Analysis of Variance:

Source	df	SS	MS	F	p
Regression	1	1.2195	1.2195	7.02	.010
Error	80	13.9024	0.1738		
Total	81	15.1220			

Table 45: Standard score method--20-point discrepancy/regression analysis. The regression equation is LD = 0.366 - 0.244 (gender).

Predictor	Coef.	SD	t-Ratio	p
Constant	0.36585	0.06510	5.62	.000
C1 (Gender)	-0.24390	0.09207	-2.65	.010

s = 0.4169 R-Square = 8.1% R-Square (adj) = 6.9%

Analysis of Variance:

Source	df	SS	MS	F	p
Regression	1	1.2195	1.2195	7.02	.010
Error	80	13.9024	0.1738		
Total	81	15.1220			

10.5% r^2 represented only a small amount of the total variance. Thus, it appeared that, at the most severe cutting level, there was minimal support for the sixth hypothesis.

Table 46: Standard score method--24-point discrepancy/regression analysis. The regression equation is LD = 0.516 - 0.173 (gender) - 0.000004 (birthweight x GA).

Predictor	Coef.	SD	t-Ratio	p
Constant	0.5165	0.1257	4.11	.000
C1 (Gender)	-0.17262	0.08084	-2.14	.036
C47 (Birthweight x GA)	-0.0000039	0.00000161	-2.43	.017

s = 0.3627 R-Square = 10.5% R-Square (adj) = 8.2%

Analysis of Variance:

Source	df	SS	MS	F	p
Regression	2	1.2160	0.6080	4.62	.013
Error	79	10.3938	0.1316		
Total	81	11.6098			

Regression analysis methods of identifying learning disabilities yielded slightly higher correlations than IEPC and standard score comparisons (see Table 42). At the 18-point level, nine variables ranging between ± 0.100 and ± 0.284 were found, with 12 variables at the 20-point level (± 0.100 to ± 0.229) and 12 variables at the 24-

point level (± 0.100 to ± 0.276). The consistently highest correlation (-0.211 to -0.284) involved male subjects being more likely to be identified as LD.

After gender, at the 18-point discrepancy level, not having respiratory distress syndrome (-0.190) and having seizures (0.193) related most to learning disabilities. However, multiple regression analysis indicated that gender, lower birth weight, being AGA, and the interaction of lower birth weight and being AGA accounted for 19.5% of the criterion's variability (Table 47). This was small, yet significant support for the sixth hypothesis.

Table 47: Regressed IQ method--18-point discrepancy/regression analysis. The regression equation is LD = 1.13 - 0.278 (gender) - 0.000366 (birthweight) - 0.848 (AGA/SGA), + 0.000440 (birthweight x AGA/SGA).

Predictor	Coef.	SD	t-Ratio	p
Constant	1.12930	0.25380	4.45	.000
C1 (Gender)	-0.27764	0.08901	-3.12	.003
C9 (Birthweight)	-0.0003658	0.0001138	-3.21	.002
C11 (AGA/SGA)	-0.84790	0.31010	-2.73	.008
C49 (Birthweight x AGA/SGA)	0.0004398	0.0001578	2.79	.007

s = 0.3975 R-Square = 19.5% R-Square (adj) = 15.4%

Analysis of Variance:

Source	df	SS	MS	F	p
Regression	4	2.9550	0.7387	4.68	.002
Error	77	12.1670	0.1580		
Total	81	15.1220			

At the 20-point discrepancy level, those variables with the highest correlation to learning disabilities included having seizures (0.240), lower birth weights (-0.229), being male (-0.211), and the interaction of lower birth weights and shorter gestational ages (-0.202). Multiple regression analysis found that being male, having lower birth weights, and having seizures accounted for 16% of this criterion's variability (Table 48).

Table 48: Regressed IQ method--20-point discrepancy/regression analysis. The regression equation is LD = 0.341 - 0.185 (gender) - 0.000178 (birthweight) + 0.257 (seizures).

Predictor	Coef.	SD	t-Ratio	p
Constant	0.34090	0.21100	1.62	.110
C1 (Gender)	-0.18476	0.08564	-2.16	.034
C9 (Birthweight)	-0.00017789	0.00007075	-2.51	.014
C17 (Seizures)	0.25720	0.12410	2.07	.042

s = 0.3809 R-Square = 16.0% R-Square (adj) = 12.8%

Analysis of Variance:

Source	df	SS	MS	F	p
Regression	3	2.1594	0.7198	4.96	.003
Error	78	11.3162	0.1451		
Total	81	13.4756			

For subjects having a 24-point or more discrepancy using regression analysis, somewhat lower correlations than the 20-point discrepancy group were found (see Table 42). These variables included being male (-0.276), having lower birth weights (-0.198), and the interaction of lower birth weights and shorter gestational ages (-0.178). The data in Table 49 show that 23.4% of the variability of the criterion was accounted for by being male, having lower birth weights, being AGA, not having an interventricular or intracranial hemorrhage (IVH), and the interaction of lower birth weights and shorter gestational ages.

Table 49: Regressed IQ method--24-point discrepancy/regression analysis. The regression equation is LD = 1.47 - 0.248 (gender) - 0.00137 (birthweight) - 0.286 (AGA/SGA) - 0.221 (IVH) + 0.000026 (birthweight x GA).

Predictor	Coef.	SD	t-Ratio	p
Constant	1.46900	0.32770	4.48	.000
C1 (Gender)	-0.24782	0.07248	-3.42	.001
C9 (Birthweight)	-0.0013674	0.0004691	-2.91	.005
C11 (AGA/SGA)	-0.28630	0.12200	-2.35	.022
C16 (IVH)	-0.22090	0.10440	-2.12	.038
C47 (Birthweight x GA)	0.00002632	0.00001052	2.50	.014

s = 0.3213 R-Square = 23.4% R-Square (adj) = 18.4%

Analysis of Variance:

Source	df	SS	MS	F	p
Regression	5	2.3987	0.4797	4.65	.001
Error	76	7.8452	0.1032		
Total	81	10.2439			

Thus, it would appear that, for groups of subjects identified as LD by regression analysis, there was a small, yet significant relationship between prenatal and perinatal variables and later learning disabilities.

As noted in the methodology section, these results should be viewed from the limiting perspective that this study was not a representative sample of the premature and small for gestational age population, particularly with respect to SES and racial composition. Also, the subjects for this study were not randomly selected. Furthermore, these findings should be interpreted with caution due to the study's small number of subjects. With these constraints in mind, comparisons to the findings of previous studies on learning disabilities are mixed. This study continues to support the overrepresentation of males as LD, and the relatively low impact of SES. Yet, for premature and/or low birth weight children identified as LD by regression analysis methods, it appears that there was a small but significant relationship of prenatal and perinatal factors with later learning disabilities.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

This dissertation investigated long-term special education outcomes for three distinct groups of premature, low birth weight infants (premature AGA, full-term SGA, and preterm SGA infants). The second part of this study was designed to look more closely at the long-term outcomes of less severe handicaps, or learning disabilities, for these groups of at-risk infants.

To address these issues, a total of 42 premature AGA infants, 26 preterm SGA infants, and 14 full-term SGA infants were followed until they were approximately 8 to 14 years of age. The 40 premature and full-term SGA subjects represented 54% and 56% of SGA infants born at E. W. Sparrow Hospital from 1977 through 1983. PTAGA subjects were selected on the basis of matching characteristics to SGA subjects.

The incidences of identified special education handicaps for the at-risk groups were compared with local population rates on the basis of gender and SES using descriptive statistics. Because of the limited number of subjects, an average of grade 2 through grade 8 rates was compared, rather than individual grade-by-grade comparisons.

Regarding special education handicap rates, it was apparent that each at-risk group's total average of subjects having handicaps exceeded the local rates. Specific at-risk groups had handicaps in four of seven areas. When the groups had representation in an individual category, their rates were higher in all areas except for speech and language impairments, and emotional impairments. Severe multiple impairments were notable, being 29 to 54 times more evident than the local averages for all groups. Physical or otherwise health impairment rates were considerably high for only PTAGA subjects.

Due to the study's limited number of subjects, it was difficult to assess the influence of gender and socioeconomic factors on special education handicaps for individual at-risk groups. However, pooled at-risk rates by gender were comparable to local rates in four of seven (EMI, LD, SLI, and EI) special education categories. Unanticipated findings were noted regarding SES. For all groups, the highest and lowest SES levels had no handicaps. The upper-middle SES level had the largest concentration of handicapped subjects for PTAGA, FTSGA, and pooled group results. However, it seemed likely that the limited number of lower SES subjects involved in this study contributed to these unexpected findings.

Retention rates for all subjects identified as eligible for special education services seemed relatively high (PTAGA--58.3%, PTSGA--100%, and FTSGA--50%). Because there was little local or national data on retentions for special or regular education students, comparisons could not be made. The more severe handicaps (SXI and EMI) had 100% of the subjects retained. Furthermore, LD subjects from PTAGA and PTSGA groups had higher rates than the limited current data. For students not involved with special education programs, PTSGA subjects had the highest incidence (38.1%) of retentions, followed by FTSGA (18.2%) and PTAGA (14.5%). When gender-based comparisons were possible, males had a larger percentage of retentions. Interestingly, lower SES seemed to relate to a higher proportion of retentions for pooled group findings. However, this trend was much more apparent for PTAGA subjects than the other at-risk groups.

Full-term SGA subjects received less regular-education-based special services than the general population. PTSGA and PTAGA groups had comparable rates. However, all three groups received more special services, combining regular and special education programs than the local population.

Regarding the initial age of special education programming, no differences were noted. Consequently, it appeared that these children were identified as readily as other handicapped children in the general population of mid-Michigan.

The second part of this dissertation investigated learning disabilities for the three groups of at-risk infants at school age, the time most LD children are identified. In comparison to local rates (5.2%), the three groups had higher incidences of IEPC identified learning disabilities (FTSGA--7.1%, PTSGA--7.7%, and PTAGA--11.6%). To control for possibly biased school district decisions and examiner differences, ability/achievement discrepancies (using both standard score differences and regression analysis models) were computed using independent testing results. In contrast to the IEPC rates, psychometric comparisons were considerably higher

(11% to 28%) for the three groups using both discrepancy methods at all cutting scores (6.5%, 5%, and 2%). Little variability was found between total numbers of LD subjects identified at each cutting score for standard score versus regression analysis methods. Likewise, only five of the seven IEPC identified students met the psychometric criteria demanded by both methods.

Matched samples of PTSGA and PTAGA children, and FTSGA and PTAGA children, were compared to detect possible differences in intelligence and academic achievement. Matches were made on the basis of gender, date of birth, SES, and birth weight or gestational age. PTSGA and PTAGA groups had no significant differences in any of the areas compared. FTSGA and PTAGA groups also had no significant differences.

Using descriptive statistics, it was apparent that both PTSGA and FTSGA subjects had a greater number of and more severe psychometric identified learning disabilities than PTAGA matches. However, these results were different from total sample comparisons, which noted generally equivalent results. Concerning whether PTSGA and FTSGA children have more ability/achievement discrepancies than PTAGA matches, few differences were apparent.

SES differences in learning disabilities were assessed by comparing high (levels 1 and 2) and lower SES (levels 4 and 5) subjects paired on the basis of their at-risk group, gender, birth date, and gestational age or birth weight. Unfortunately, only eight pairs of subjects met these matching criteria. Thus, the conclusions should be viewed with caution. Lower SES subjects had significantly lower achievement in four of eight academic areas (reading recognition, reading comprehension, spelling/written language, and math computation). Psychometrically identified discrepancies were also more evident and more extensive for lower SES-level subjects than higher level SES matches.

Looking at differences between at-risk IEPC identified LD children and local LD students without prenatal and perinatal concerns, only one significant discrepancy was apparent. Block Design subtest scaled scores on the WISC-R were much lower for at-risk subjects ($p = .039$). Otherwise, no significant differences were evident on other ability test subtests or the six academic achievement measures.

The strength of relationship between SES and prenatal and perinatal variables relating to learning disabilities was assessed by using correlational and multiple regression analysis. For IEPC identified LD subjects, a small, yet significant relationship was evident regarding lower maternal education and smaller family size only. Gender was the only significant variable to account for a small portion of the variance using standard score discrepancy methods at the lower cutting scores. With the most severe cutting score using standard score discrepancy methods, and regression analysis at all cutting scores, a small relationship was evident involving gender, lower birth weights, and the interaction of lower birth weights and shorter gestational ages. However, these results should be viewed with caution as this population may not be representative of all premature and small for gestational age infants.

Implications for Future Research

The results of this study suggest several areas for future research. The most immediate area of concern involves the need to further assess notably higher incidence of severe multiple impairments (SXI) and physically or otherwise health impairments (POHI) in premature and/or low birth weight infants. This information will prove valuable to medical and educational practitioners working with developmental disabilities, as well as important for the general public to become more aware of specific risk factors relating to these profound handicaps.

Another area to be addressed involves the relationship between SES and special education handicaps. However, it appeared that lower SES groups had lower academic achievement than higher SES groups. Whether lower SES levels are overrepresented in various special education categories needs to be investigated further. Likewise, the greater incidence of male lower SES retentions needs to be evaluated in the general population. In that light, current retention rates across the country need to be determined.

Looking at groups of at-risk children, replication of this study should involve a random sample of the groups, representing all age or grade levels and SES levels. A greater representation of minority subjects would also allow the selection of groups' race/ethnicity. It is acknowledged that the sample of subjects used in the present study was not randomly selected from a well-defined population. The generalizability of these results is limited by this constraint.

Another area of interest includes the future use of regression analysis methods to study learning disabilities for at-risk populations. It was evident that regression analysis was more likely to identify prenatal and perinatal factors with this study's subjects than standard score methods. Previous researchers' difficulties in determining different LD etiologies may be limited by measurement bias of standard score methods and/or the minimal use of empirical data employed by IEPCs in making eligibility decisions.

Finally, special educators should recognize that current referral practices are as likely to overdiagnose learning disabilities as they may simply not find students with significant ability/achievement discrepancies. For investigations of learning disabilities, it is important for prudent researchers to have independent empirical data to ascertain whether LD children do, in fact, have a significant discrepancy. It should also be recognized that statistically significant ability/achievement discrepancies are a necessary but not sufficient condition for the formal diagnosis of learning disabilities. As many authors in this area have noted, discrepancies have numerous etiologies and may not necessarily warrant special interventions.

Implications for Practice and Policy

For medical and special education practitioners, this study's findings noting the relationship of premature birth and low birth weight to reading retardation need to be integrated into their professional practices. For example, school psychologists would need to be certain they included questions about these prenatal conditions when interviewing parents during the process of their psychoeducational evaluations. Likewise, medical personnel will need to inform families about their children's increased educational risks at school age.

This higher rate of handicaps might also be considered as a source of institutional policy. An example of how this information might affect institutional policies would involve such prevention-oriented programs as Head Start, targeting these at-risk children as one of their priority referral groups, or the state of Michigan continuing the funding for Sparrow Hospital's DAC in order to track children's progress and provide on-going information for the children's families.

Regarding the dramatically high incidence of SXI and POHI for premature and/or low birth weight children, it would seem that this relationship presents ethical questions. For example, is it ethical to save and care for these handicapped individuals at great expense, when other at-risk children might better use these financial resources? This is an obvious issue in times of limited resources. Other concerns involve what should be considered an adequate level of medical and educational care. Or, what is the value of these children to society, give their potential for self-sufficiency? It would seem that educational and medical practitioners will need to consider these and other ethical issues when working with these individuals and their families. Beyond ethical concerns, the fields of medicine and education need to develop appropriate programs to meet the needs and legal demands for this special group of children and their families.

For the DAC of Sparrow Hospital, it is recommended that SES information be systematically obtained on their patients and families. It is also recommended that consents to view school records be signed before the children graduate from the clinic. These actions would help future researchers follow these at-risk children, and at the same time limit future intrusive contacts.

APPENDICES

APPENDIX A

CONSENT TO PARTICIPATE IN RESEARCH

(RNICU GRADUATES)

Consent to Participate in Research

You are invited to participate in a study of educational outcomes for premature and low birth weight graduates of Sparrow Hospital's Regional Neonatal Intensive Care Unit (RNICU). This study will compare intellectual abilities, academic achievement, the prevalence of special education handicaps, and the need for special services of RNICU graduates with area school populations. Special attention will be directed at identifying learning disabilities, as this handicap is most frequently diagnosed when children are in their second to fourth grade years. Because school achievement and learning disabilities can be associated with many factors, this study will also attempt to define the relative importance of a number of possible concerns with long-term educational outcomes. They include: prematurity, low birth weight, intrauterine growth retardation, episodes of otitis media, birth asphyxia, length of initial hospitalization, time on ventilator, intraventricular hemorrhage, race, gender, maternal/paternal education, maternal/paternal occupation, family composition, birth order, and family size.

In order to pursue this study, parents of RNICU graduates will need to give their consent for this researcher to view their Sparrow Hospital's Developmental Assessment Clinic file, and to review their child's local school district file. In addition, parents will need to answer a brief questionnaire (5 minutes) regarding their current occupation and educational background, as this information was not routinely sought by the DAC. Beyond the review of the two records and the questionnaire, there will be no direct contacts with any of the children or their families.

It is important to study the long-term educational outcomes for preterm and low birth weight infants, as some researchers have suggested that the longstanding decrease in the rate of severe handicaps for these children may be negated by an increase in less severe handicaps, or learning disabilities. At present, little is actually known about the relationship between prematurity, low birth weight and learning disabilities.

As a potential benefit, participants may have the study's results made available, or to consult with the researcher regarding specific concerns over their child's educational progress.

It should be understood that all information viewed, or used in this study will be treated in a confidential manner. Likewise, individual children or their families will not be identified in the study results. Graduates will be identified by number only.

There will be no financial obligations for RNICU graduates and their families to participate in this study, or to use the researcher's consultant services.

Parents have the option to withdraw their consent or involvement in this study at any time, or to choose to not participate. Either way you may decide, your decision will not jeopardize future treatment by the Sparrow Hospital or this researcher. This study is being used as my doctoral dissertation in School Psychology at Michigan State University, and has been authorized with parental consent by Sparrow Hospital's Institutional Research Review Committee.

Also, please discuss this study with your child. Although their written consent is not required if they are 12 years old or younger, it is important to advise them of the purpose of this investigation, their unique role in it, and to obtain their verbal permission.

Should you have questions about this study or wish to consult with this researcher, please contact Mike Monroe (office: 543-5500, and evenings: 887-2023).

Mike Monroe Ed.Spec., NCPS
Michigan Approved School Psychologist
Doctoral Candidate,
Department of Counseling, Educational Psychology
and Special Education.
Michigan State University

Consent Agreement

I acknowledge receipt of a copy of this consent form, and give my permission to Sparrow Hospital and Mike Monroe to review the file of   , my child's DAC and local school district file. You indicate your voluntary agreement to participate by completing and returning this questionnaire and consent form. (Please keep the preceding study and consent description for your information)

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parent/guardian signature date

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child's signature (13 years and older) date

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witness signature date

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researcher signature date

RNICU Graduate Follow-up Questionnaire

1. Family Composition (please list all members of your immediate family, and circle the names of those with whom your child resides).

	Name	Age	Occupation (or give a brief description of your work, parents and guardians only)

Mother:____.
Father:____.
Step-parents ____.
or guardians:____.
Children:___________________________.
___________________________.
___________________________.
___________________________.
___________________________.
___________________________.

2. Parents' or Guardians' Education (please check for each that apply).

	Mother	Father	Guardian/ Stepmother	Guardian/ Stepfather
a. less than 7th grade	___	___	___	___.
b. junior high school (7th to 9th grade)	___	___	___	___.
c. partial high school (10th or 11th grade)	___	___	___	___.
d. high school graduate	___	___	___	___.
e. partial college or specialized training (at least one year)	___	___	___	___.
f. standard college or university graduation	___	___	___	___.
g. graduate professional training (graduate degree)	___	___	___	___.

3. Where does your child (RNICU graduate) currently go to school? (please note the school name and/or school district)

4. Would you like a copy of this study's results?___Yes___No

Please return the consent form and the completed questionnaire in the enclosed envelope. Thank you for your time, and your concern for the welfare of children.

APPENDIX B

CONSENT TO PARTICIPATE IN RESEARCH

(EATON INTERMEDIATE SCHOOL DISTRICT LD)

Consent to Participate in Research

You are invited to participate in a study that is attempting to identify the existence of distinct patterns or types of learning disabilities. As part of a larger investigation looking at educational outcomes for premature and low birth weight infants at 7 to 13 years of age, this study will compare intellectual abilities and academic achievement of learning disabled children from a variety of medical and family-related backgrounds. Because school achievement and learning disabilities can be associated with many factors, this research will attempt to define the relative importance of a number of possible concerns with long-term educational outcomes. They include: prematurity, low birth weight, intrauterine growth retardation, episodes of otitis media, birth asphyxia, length of initial hospitalization, time on ventilator, intraventricular hemorrhage, race, gender, maternal/paternal education, maternal/paternal occupation, family composition, birth order, and family size.

In order to pursue this study, parents of children with learning disabilities will need to give their consent for this researcher to view their Eaton Intermediate School District file and to answer a brief questionnaire (5 minutes) regarding their current occupation and educational background, as this information was not routinely sought by Eaton I.S.D.. Beyond the review of these records and the questionnaire, there will be no direct contacts with any of the children or their families.

It is important to study the long-term educational outcomes for preterm and low birth weight infants, as some researchers have suggested that the longstanding decrease in the rate of severe handicaps for these children may be negated by an increase in less severe handicaps, or learning disabilities. At present, little is actually known about the relationship between prematurity, low birth weight and learning disabilities. Likewise, it is important to look for specific reasons for learning disabilities, as this may relate to a better understanding of our students' prognosis and perhaps better instructional practices.

As a potential benefit, participants may have the study's results made available, or to consult with the researcher regarding specific concerns over their child's educational progress.

It should be understood that all information viewed, or used in this study will be treated in a confidential manner. Likewise, individual children or their families will not be identified in the study results. Students will be identified by number only.

There will be no financial obligations for Eaton I.S.D. students and their families to participate in this study, or to use the researcher's consultant services.

Parents have the option to withdraw their consent or involvement in this study at any time, or to choose to not participate. Either way you may decide, your decision will not jeopardize future treatment by the Eaton Intermediate School District or this psychologist. This study is being used as my doctoral dissertation in School Psychology at Michigan State University, and has been authorized with parental consent by the Eaton Intermediate School District.

Also, please discuss this study with your child. Although their written consent is not required if they are 12 years old or younger, it is important to advise them of the purpose of this investigation, their unique role in it, and to obtain their verbal permission.

Should you have questions about this study or wish to consult with this researcher, please contact Mike Monroe (office: 543-5500, and evenings: 626-6087).

Mike Monroe Ed.Spec., NCPS
Michigan Approved School Psychologist
Eaton Intermediate School District
Doctoral Candidate,
Department of Counseling, Educational Psychology
and Special Education.
Michigan State University

Consent Agreement

I acknowledge receipt of a copy of this consent form, and give my permission to Eaton Intermediate School District and Mike Monroe to review the file of   , my child's Intermediate School District file. You indicate your voluntary agreement to participate by completing and returning this questionnaire and consent form. (Please keep the preceding study and consent description for your information)

-------------------------   -----------
parent/guardian signature   date

-------------------------   -----------
child's signature   date
(13 years and older)

-------------------------   -----------
witness signature   date

-------------------------   -----------
researcher signature   date

Learning Disabilities Questionnaire

1. Family Composition (please list all members of your immediate family, and circle the names of those with whom your child resides).

Name	Age	Occupation (or give a brief description of your work, parents and guardians only)

Mother:____.
Father:____.
Step-parents ____.
or guardians:____.
Children:_____________________________.
_____________________________.
_____________________________.
_____________________________.
_____________________________.
_____________________________.

2. Parents' or Guardians' Education (please check for each that apply).

	Mother	Father	Guardian/ Stepmother	Guardian/ Stepfather
a. less than 7th grade	___	___	___	___.
b. junior high school (7th to 9th grade)	___	___	___	___.
c. partial high school (10th or 11th grade)	___	___	___	___.
d. high school graduate	___	___	___	___.
e. partial college or specialized training (at least one year)	___	___	___	___.
f. standard college or university graduation	___	___	___	___.
g. graduate professional training (graduate degree)	___	___	___	___.

3. Did you child weigh less than 2500 grams or 5 lbs 8 oz at birth?
___Yes ___No

4. Was your child born premature (pregnancy of 38 weeks or less)?
___Yes ___No

5. Would you like a copy of this study's results?___Yes___No

Please return the consent form and the completed questionnaire in the enclosed envelope. Thank you for your time, and your concern for the welfare of children.

APPENDIX C

E. W. SPARROW HOSPITAL RESEARCH APPROVAL

SPARROW
HOSPITAL

March 18, 1991

David Sciamanna, D.O.
Michael Monroe, Ph.D.
Neonatology Office
Sparrow Hospital
Lansing, MI 48912

RE: "Special Education Outcomes for Premature and/or Low Birth Weight Infants, and the Effects of Prematurity, Intrauterine Growth Retardation, and Socioeconomic Status on Specific Learning Disabilities."

Dear Drs. Sciamanna/Monroe:

Thank you for your presentation of the above mentioned study at the March 12, 1991 meeting of the Sparrow Hospital Institutional Research and Review Committee.

This letter is to summarize the results of the discussion pertaining to your proposal. The protocol has been approved. However, it was noted that parental consent must be obtained before data from the developmental assessment clinic and schools could be obtained and it also would require consent of child over age 13.

Please be reminded to keep the Committee informed of the status of this protocol by providing an annual update report.

Sincerely,

R. L. Hatton M.D.

Richard L. Hatton, M.D., Chairman
Institutional Research & Review Committee
Sparrow Hospital

RLH:js

1215 East Michigan Avenue
P.O. Box 30480, Lansing, Michigan 48909-7980

APPENDIX D

EATON INTERMEDIATE SCHOOL DISTRICT RESEARCH APPROVAL

EATON INTERMEDIATE SCHOOL DISTRICT
1790 East Packard • Charlotte, MI 48813
Superintendent F. James McBride

Mike Monroe
Doctoral Candidate
Michigan State Department of Counseling
East Lansing, Michigan 48823

Dear Mr. Monroe:

After reviewing your proposal and given the assurance that:

1. Parental consent is required before a students file is reviewed.
2. All personal identifying information is deleted from your study.
3. Participants may have the study's results available.
4. Parents have the option to withdraw their consent or involvement in this study at any time.

Permission is given to our Registrar to give you the sampling you requested.

Wayne Buletza — 3/26/91
Dr. Wayne Buletza, Special Education Director — Date

Jo Gager — 3/26/91
Jo Gager, Planner Monitor — Date

Administrative/Special Services	Meadowview School	Employment Service Center	Southridge Vocational Center	Lansing Community College Gannon Vo-Tech Center
1790 E. Packard	1790 E. Packard	420 High St.	311 W. First St.	Rm. 464
Charlotte, MI	Charlotte, MI	Potterville, MI	Charlotte, MI	Lansing, MI
543 [illegible] 484-2020	543-5500 484-2020	645-7646	543-5500/484-2020	483-1228
FAX 543-4633	FAX 543-[illegible]	FAX 543-6633	FAX 543-6016	FAX 543-6633

Eaton Intermediate is an equal opportunity employer that offers students programs and services without regard to sex, race, creed, national origin or handicap

APPENDIX E

PTSGA/FTSGA SUBJECT POOL

PTSGA/FTSGA Subject Pool

		Male	Female	Total	(inactive/premature exit)
1978	FT	2	6	6	2
	PT	12	5	8	9
1979	FT	2	3	3	2
	PT	6	8	11	3
1980	FT	3	3	2	4
	PT	5	4	7	2
1981	FT	1	2	2	1
	PT	4	2	4	2
1982	FT	2	1	2	1
	PT	3	6	9	0
		40	40	54	26

APPENDIX F

SUBJECT DATA

Gestational Age

	PTSGA	PTAGA	FTSGA
27 weeks	1	2	
28 weeks	3	3	
29 weeks		1	
30 weeks		1	
31 weeks	2	1	
32 weeks	3	3	
33 weeks	2	7	
34 weeks	6	5	
35 weeks	2	8	
36 weeks	6	5	
37 weeks	1	4	
38 weeks		2	1
39 weeks			1
40 weeks			8
41 weeks			2
42 weeks			2

Birth Weights	PTSGA	PTAGA	FTSGA
500 to 600g	1		
601 to 700g	1		
701 to 800g	2		
801 to 900g	2		
901 to 1000g		2	
1001 to 1100g	2		
1101 to 1200g	1	2	
1201 to 1300g	2		
1301 to 1400g	1		
1401 to 1500g	6	3	1
1501 to 1600g	2	3	
1601 to 1700g	3		
1701 to 1800g	1	1	
1801 to 1900g		2	2
1901 to 2000g		1	2
2001 to 2100g	2	8	
2101 to 2200g			1
2201 to 2300g		4	
2301 to 2400g		3	3
2401 to 2500g		2	2
2501 to 2600g		2	1
2601 to 2700g		5	1
2701 to 2800g		2	1
2801 to 2900g			
2901 to 3000g		1	
3000g +		1	

PTSGA Subjects' Schools

Alpena, Montmorency, Alcona Intermediate School District
Bath Public Schools
Charlotte Public Schools
Eaton Rapids Public Schools
Grand Ledge Public Schools
Holt Public Schools
Hope Academy (Lansing)
Lansing Christian School
Lansing Public Schools
Mason Public Schools
Mount Pleasant Public Schools
Naperville Public Schools (Illinois)
Owosso Public Schools
Perry Public Schools
Potterville Public Schools
St. Johns Public Schools
St. Michael's Catholic School (Grand Ledge)
St. Patrick's Catholic School (Portland)
St. Paul's Catholic School (Owosso)
Waverly Public Schools

FTSGA Subjects' Schools

Benzie Central Public Schools
DeWitt Public Schools
East Lansing Public Schools
Ingham Intermediate School District
Lake Odessa Public Schools
Laingsburg Public Schools
Lansing Public Schools
Maple Valley Public Schools
Mason Public Schools
Saints Peter and Paul Lutheran School (St. Johns)

PTAGA Subjects' Schools

Alma Public Schools
Chesaning Public Schools
Eaton Intermediate School District
Eaton Rapids Public Schools
Grand Ledge Public Schools
Haslett Public Schools
Hillman Public Schools
Holt Public Schools
Hope Academy (Lansing)
Jackson Public Schools
Lansing Christian School
Lansing Public Schools
Maple Valley Public Schools
Mason Public Schools
Okemos Public Schools
Olivet Public Schools
Owosso Public Schools
Resurrection Catholic School (Lansing)
Saginaw Intermediate School District
St. Johns Public Schools
St. Michael's Catholic School (Grand Ledge)
Waverly Public Schools
Webberville Public Schools

APPENDIX G

MICHIGAN SPECIAL EDUCATION GUIDELINES

Revised Administrative Rules
for
Special Education
and

Rules for
School Social Worker
and
School Psychological Services

Important

These rules will not take effect until July of 1987. They are being distributed to assist the readers in becoming acquainted with the revised Administrative Rules for Special Education.

Michigan State Board of Education
Special Education Services
P.O. Box 30008
Lansing, Mi. 48909
November, 1986

the unique educational needs of the special education student and is designed to develop the maximum potential of the special education student. All of the following are included in the definition of special education:

(i) Classroom instruction.

(ii) Instruction in physical education.

(iii) Instructional services defined in R 340.1701a(d).

(iv) Ancillary and other related services where specially designed instruction is provided and as identified in R 340.1701(c) (ii), (iii),(v), (vi), and (vii).

(f) "Special education advisory committee" means a committee appointed by the state board of education to advise the state board of education on matters related to the delivery of special education programs and services.

(g) "Special education classroom" means a classroom that is under the direction of an approved special education teacher and in which a person receives specially designed instruction.

(h) "Specialized transportation" means transportation provided in an approved school vehicle in a regular seat, wheelchair, or an approved baby seat. This specifically excludes students who need ambulance service, a medical attendant, or other care outside the responsibility of the schools.

(i) "Superintendent" means the chief executive officer of the public agency or his or her designee.

(j) "Vocational education" means vocational education as defined in section 7 of Act No. 451 of the Public Acts of 1976, as amended, being §380.7 of the Michigan Compiled Laws.

(k) "Vocational evaluation" means an evaluation conducted before vocational education, which shall include, at a minumum, an assessment of the student's personál adjustment skills, aptitudes, interests, and achievements and special information regarding the student's handicapping condition.

(l) "Work activity center" means a program designed exclusively to provide therapeutic activities for handicapped persons whose handicap is so severe that their productive capacity is inconsequential. A work activity center may be operated in conjunction with a sheltered workshop licensed under the fair labor standards act of 1938, as amended, 29 U.S.C. §201 et seq.

(m) "Youth placed in a juvenile detention facility" means an individual who is placed by the court in a detention facility for juvenile delinquents and who is not attending a regular school program due to court order.

R 340.1702 "Handicapped person" defined.

Rule 2. "Handicapped person" means a person who is under 26 years of age and who is determined by an individualized planning committee or a hearing officer to have a characteristic or set of characteristics pursuant to R 340.1703 to R 340.1715 that necessitates special education or ancillary and other related services, or both. Determination of an impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1703 Determination of severely mentally impaired.

Rule 3.(1) The severely mentally impaired shall be determined through manifestation of all of the following behavioral characteristics:

(a) Development at a rate approximately 4 1/2 or more standard deviations below the mean as determined through intellectual assessment.

(b) Lack of development primarily in the cognitive domain.

(c) Impairment of adaptive behavior.

(2) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team which shall include a psychologist.

(3) A determination of impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1704 Determination of trainable mentally impaired.

Rule 4.(1) The trainable mentally impaired shall be determined through manifestation of all of the following behavioral characteristics:

(a) Development at a rate approximately 3 to 4 1/2 standard deviations below the mean as determined through intellectual assessment.

(b) Lack of development primarily in the cognitive domain.

(c) Impairment of adaptive behavior.

(2) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team which shall include a psychologist.

(3) A determination of impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1705 Determination of educable mentally impaired.

Rule 5.(1) The educable mentally impaired shall be determined through the manifestation of all of the following behavioral characteristics:

(a) Development at a rate approximately 2 to 3 standard deviations below the mean as determined through intellectual assessment.

(b) Scores approximately within the lowest 6 percentiles on a standardized test in reading and arithmetic.

(c) Lack of development primarily in the cognitive domain.

(d) Impairment of adaptive behavior.

(2) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team which shall include a psychologist.

(3) A determination of impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1706 Determination of emotionally impaired.

Rule 6.(1) The emotionally impaired shall be determined through manifestation of behavioral problems primarily in the affective domain, over an extended period of time, which adversely affect the person's education to the extent that the person cannot profit from regular learning experiences without special education support. The problems result in behaviors manifested by 1 or more of the following characteristics:

(a) Inability to build or maintain satisfactory interpersonal relationships within the school environment.

(b) Inappropriate types of behavior or feelings under normal circumstances.

(c) General pervasive mood of unhappiness or depression.

(d) Tendency to develop physical symptoms or fears associated with personal or school problems.

(2) The term "emotionally impaired" also includes persons who, in addition to the above characteristics, exhibit maladaptive behaviors related to schizophrenia or similar disorders. The term "emotionally impaired" does not include persons who are socially maladjusted, unless it is determined that such persons are emotionally impaired.

(3) The emotionally impaired shall not include persons whose behaviors are primarily the result of intellectual, sensory, or health factors.

(4) A determination of impairment shall be based on data provided by a multidisciplinary team, which shall include a comprehensive evaluation by both of the following:

(a) A psychologist or psychiatrist.
(b) A school social worker.
(5) A determination of impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1707 Determination of hearing impaired.

Rule 7.(1) The term "hearing impaired" is a generic term which includes both deaf persons and those who are hard of hearing and which refers to students with any type or degree of hearing loss that interferes with development or adversely affects educational performance in a regular classroom setting. The term "deaf" refers to those hearing impaired students whose hearing loss is so severe that the auditory channel is not the primary means of developing speech and language skills. The term "hard of hearing" refers to those hearing impaired students with permanent or fluctuating hearing loss which is less severe than the hearing loss of deaf persons and which generally permits the use of the auditory channel as the primary means of developing speech and language skills.
(2) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team which shall include an audiologist and an otolaryngologist or otologist.
(3) A determination of impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1708 Determination of visually impaired.

Rule 8.(1) The visually impaired shall be determined through the manifestation of both of the following:
(a) A visual impairment which interferes with development or which adversely affects educational performance.
(b) One or more of the following:
(i) A central visual acuity for near or far point vision of 20/70 or less in the better eye after routine refractive correction.
(ii) A peripheral field of vision restricted to not more than 20 degrees.
(iii) A diagnosed progressively deteriorating eye condition.
(2) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team which shall include an ophthalamologist or optometrist.
(3) A determination of impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1709 Determination of physically and otherwise health impaired.

Rule 9.(l) The physically and otherwise health impaired shall be determined through the manifestation of a physical or other health impairment which adversely affects educational performance and which may require physical adaptations within the school environment.
(2) Determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team, which shall include 1 of the following:
(a) An orthopedic surgeon.
(b) An internist.
(c) A neurologist.
(d) A pediatrician.
(e) Any other approved physician as defined in Act No. 368 of the Public Acts of 1978, as

amended, being §333.1101 et seq. of the Michigan Compiled Laws.

(3) A determination of impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1710 Determination of speech and language impaired.

Rule 10.(1) The speech and language impaired shall be determined through the manifestation of 1 or more of the following communication impairments which adversely affects educational performance.

(a) Articulation impairment, including omissions, substitutions, or distortions of sound, persisting beyond the age at which maturation alone might be expected to correct the deviation.

(b) Voice impairment, including inappropriate pitch, loudness, or voice quality.

(c) Fluency impairment, including abnormal rate of speaking, speech interruptions; and repetition of sounds, words, phrases, or sentences, which interferes with effective communication.

(d) One or more of the following language impairments: phonological, morphological, syntactic, semantic, or pragmatic use of aural/oral language as evidenced by both of the following:

(i) A spontaneous language sample demonstrating inadequate language functioning.

(ii) Test results, on not less than 2 standardized assessment instruments or 2 subtests designed to determine language functioning, which indicate inappropriate language functioning for the child's age.

(2) A handicapped person who has a severe speech and language impairment but whose primary disability is other than speech and language shall be eligible for speech and language services pursuant to R 340.1745(a).

(3) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary team which shall include a teacher of the speech and language impaired.

(4) A determination of impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1711 "Preprimary impaired" defined; determination.

Rule 11.(1) "Preprimary impaired" means a child through 5 years of age whose primary impairment cannot be differentiated through existing criteria within R 340.1703 to R 340.1710 or R 340.1713 to R 340.1715 and who manifests an impairment in 1 or more areas of development equal to or greater than 1/2 of the expected development for chronological age, as measured by more than 1 developmental scale which cannot be resolved by medical or nutritional intervention. This definition shall not preclude identification of a child through existing criteria within R 340.1703 to R 340.1710 or R 340.1713 to R 340.1715.

(2) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team.

(3) A determination of impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1713 "Specific learning disability" defined; determination.

Rule 13.(1) "Specific learning disability" means a disorder in 1 or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain disfunction, dyslexia, and developmental aphasia. The term does not include children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, of mental retardation, of emotional disturbance, of autism, or of environmental, cultural, or economic disadvantage.

(2) The individualized educational planning committee may determine that a child has a specific learning disability if the child does not achieve commensurate with his or her age and ability levels in 1 or more of the areas listed in this subrule, when provided with learning experiences appropriate for the child's age and ability levels, and if the mutlidisciplinary evaluation team finds that a child has a severe discrepancy between achievement and intellectual ability in 1 or more of the following areas:

(a) Oral expression.

(b) Listening comprehension.

(c) Written expression.

(d) Basic reading skill.

(e) Reading comprehension.

(f) Mathematics calculation.

(g) Mathematics reasoning.

(3) The individualized educational planning committee shall not identify a child as having a specific learning disability if the severe discrepancy between ability and achievement is primarily the result of any of the following:

(a) A visual, hearing, or motor handicap.

(b) Mental retardation.

(c) Emotional disturbance.

(d) Autism.

(e) Environmental, cultural, or economic disadvantage.

(4) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team, which shall include at least both of the following:

(a) The child's regular teacher or, if the child does not have a regular teacher, a regular classroom teacher qualified to teach a child of his or her age or, for a child of less than school age, an individual qualified by the state educational agency to teach a child of his or her age.

(b) At least 1 person qualified to conduct individual diagnostic examinations of children, such as a school psychologist, a teacher of speech and language impaired, or a teacher consultant.

R 340.1714 Determination of severely multiply impaired.

Rule 14.(1) Students with severe multiple impairments shall be determined through the manifestation of either of the following:

(a) Development at a rate of 2 to 3 standard deviations below the mean and 2 or more of the following conditions:

(i) A hearing impairment so severe that the auditory channel is not the primary means of developing speech and language skills.

(ii) A visual impairment so severe that the visual channel is not sufficient to guide independent mobility.

(iii) A physical impairment so severe that activities of daily living cannot be achieved without assistance.

(iv) A health impairment so severe that the student is medically at risk.

(b) Development at a rate of 3 or more standard deviations below the mean or students for whom evaluation instruments do not provide a valid measure of cognitive ability and 1 or more of the following conditions:

(i) A hearing impairment so severe that the auditory channel is not the primary means of developing speech and language skills.

(ii) A visual impairment so severe that the visual channel is not sufficient to guide independent mobility.

(iii) A physical impairment so severe that activities of daily living cannot be achieved without assistance.

(iv) A health impairment so severe that the student is medically at risk.

(2) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team, which shall include a psychologist and, depending upon the handicaps in the physical domain, the multidisciplinary evaluation team participants required in R 340.1707, R 340.1708, or R 340.1709.

(3) A determination of impairment shall not be based solely on behaviors relating to environmental, cultural, or economic differences.

R 340.1715 "Autism" defined; determination.

Rule 15.(1) "Autism" means a lifelong developmental disability which is typically manifested before 30 months of age. "Autism" is characterized by disturbances in the rates and sequences of cognitive, affective, psychomotor, language, and speech development.

(2) The manifestation of the characteristics specified in subrule (1) of this rule and all of the following characteristics shall determine if a person is autistic:

(a) Disturbance in the capacity to relate appropriately to people, events, and objects.

(b) Absence, disorder, or delay of language, speech, or meaningful communication.

(c) Unusual, or inconsistent response to sensory stimuli in 1 or more of the following:

(i) Sight.

(ii) Hearing.

(iii) Touch.

(iv) Pain.

(v) Balance.

(vi) Smell.

(vii) Taste.

(viii) The way a child holds his or her body.

(d) Insistence on sameness as shown by stereotyped play patterns, repetitive movements, abnormal preoccupation, or resistance to change.

(3) To be eligible under this rule, there shall be an absence of the characteristics associated with schizophrenia, such as delusions, hallucinations, loosening of associations, and incoherence.

(4) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team. The team shall include, at a minimum, a psychologist or psychiatrist, a teacher of speech and language impaired, and a school social worker.

(5) A determination of impairment shall not be based solely on, behaviors relating to environmental, cultural, or economic differences.

APPENDIX H

TESTS USED

Tests Used

	PTAGA	PTSGA	FTSGA	TOTAL
IQ Tests:				
Binet L-M	23	14	10	47
Binet 4-E	8	6	2	16
WISC-R	10	4	1	15
Cattell		1		1
WIPPSI		1		1
Bayley			1	1
PPVT-R	1			1
Achievement:				
SAT	20	13	7	40
CAT	4	1	1	6
CTBS	1	3		4
KTEA	3	2		5
WJ-R	2	1	2	5
WRAT-R	6	2	2	10
Vineland	1	1		2
BASIS	1	1		2
Iowa		1	1	2
PIAT-R	1			1
MAT	2			2
Pyramid	1			1
Informal		1		1

APPENDIX I

TEST RELIABILITIES

Test Reliabilities

Basic Achievement Skill Individual Screener (BASIS)

Internal consistency coefficients were predominantly in the .90s. Test-retest coefficients were as follows (Taylor, 1989):

Grade	2	5	8
Math	.81	.83	.88
Reading	.91	.82	.96
Spelling	.94	.90	.94

California Achievement Tests: Forms C and D (CAT)

Internal consistency reliability coefficients were reported for each level and for each group. Total battery reliabilities ranged from .89 to .98, with the vast majority at or above .95. The various subtests (e.g., reading comprehension, math concepts) have lower internal consistency reliability coefficients (Keyser & Sweetland, 1985).

Comprehensive Tests of Basic Skills: Forms U and V (CTBS)

Internal consistency reliability coefficients (KR 20) ranged from a low of .65 on the Level A Vocabulary Test for grade K1 to a high of .95 on the Level G Vocabulary and Reading Comprehension Tests at the sixth grade. Most of the coefficients were .90 and above, with all coefficients for combined tests above .90 on tests at Level C and above (Keyser & Sweetland, 1985).

Iowa Tests of Basic Skills: Forms G and H (IOWA)

Test reliabilities for the subtests tended to be in the .80s and .90s, although they were somewhat lower for the Level 5 and 6 subtests and for the Listening subtest at all four levels in which it was included (Keyser & Sweetland, 1985).

Kaufman Test of Education Achievement (KTEA)

Internal consistency was measured using Guilford's (1954) formula, and the results showed strong reliability in this area. Test-retest results showed .90 or better coefficients. Interform reliability coefficients were in the low .90s, with a range from .87 to .96 for the different grade levels and .90 to .97 for the separate age groups (Keyser & Sweetland, 1985).

Metropolitan Achievement Test: 5th Edition (MAT)

Internal consistency coefficients ranged from .85 to .96 for Reading skills, from .77 to .90 for Mathematics, and from .72 to .92 for Language skills. Test-retest results ranged from .73 (rate of comprehension) to .92 (comprehension) according to Keyser and Sweetland (1985).

Peabody Individual Achievement Test--Revised (PIAT-R)

Split-half reliability of the PIAT-R ranged from .84 for kindergarten mathematics to .98 for third-grade reading recognition. The median split-half reliability for the total test was .98. Test-retest reliabilities for 2- to 4-week periods ranged in the low to upper .90s for composite correlation and in the mid-.80s to high .90s for individual subtests.

Peabody Picture Vocabulary Test--Revised (PPVT-R)

Split-half coefficients were .84 for Form L and .81 for Form M. Alternate form coefficients ranged from .77 to .79 according to Taylor (1989).

Pyramid Scales

Test-retest coefficients ranged from .58 for vocabulary to .97 for fine-motor skills. The total test coefficient was .88. The internal consistency coefficient was .92 according to Keyser and Sweetland (1985).

Stanford Achievement Test: 7th Edition (SAT)

Reliability of the SAT subtests included three approaches: (a) internal consistency, (b) alternate forms, and (c) consistency over time. Reliability coefficients were respectable for the subtests, often clustering around .90 according to Keyser and Sweetland (1985).

Stanford-Binet: 4th Edition

Internal consistency coefficients were generally above .90. Test-retest coefficients ranged from .71 (QR) to .91 (total test composite) for a preschool sample and from .51 to .90 for an elementary school sample (taylor, 1989).

	KR 20	5/8 yrs.	Retest	5/8 yrs.
Verbal Reasoning	.93	.92	.88	.87
Abstract/Visual Rsng	.93	.95	.81	.67
Quantitative Rsng	.88	.92	.71	.51
Short-Term Memory	.92	.93	.78	.81
Composite	.97	.97	.91	.90

Vineland Adaptive Behavior Scales

Split-half correlations ranged from a low of .83 for the Motor Skills domain to .94 for the Adaptive Behavior Composite scores on the Survey Form. Over the whole age range, domain test-retest coefficients ran .98 to .99 (Keyser & Sweetland, 1985).

Wide Range Achievement Test--Revised (WRAT-R)

Internal reliability coefficients were in the .90s for most age groups. Test-retest coefficients were as follows (Taylor, 1989):

	Reading	Spelling	Arithmetic
Level 1	.96	.97	.94
Level 2	.90	.89	.79

Woodcock-Johnson Psycho-Educational Battery (WJ)

Split-half coefficients for the subtests ranged from .78 to .95 (Taylor, 1989). Internal consistency reliability coefficients were as follows:

Letter/Word Identification	.918
Passage Comprehension	.902
Math Calculation	.932
Dictation	.915
Broad Reading	.951
Broad Math	.952
Broad Written Language	.942

NON-BIASED ASSESSMENT OF HIGH INCIDENCE SPECIAL EDUCATION STUDENTS

(Learning Disabled, Educable Mentally Impaired and Emotionally Impaired)

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Published October, 1981

Name:	Bayley Scales of Infant Development
Author:	Nancy Bayley
Publisher:	The Psychological Corporation
Copyright:	1969
Administration:	Individual, 45-75 minutes (with breaks possible) Mother or surrogate holds infants.
Levels:	2-30 months
Scores:	Deviation developmental scores M=100; S.D. = 15 Mental Developmental Index (MDI) Psychomotor Developmental Index (PDI) Behavior Rating Profile
Skills Tested:	General intellectual skills. The specific skills vary with different ages. In general, non-verbal and motor responses are stressed, to non-verbal and verbal stimuli. Requires child to follow verbal directions within the context of suggestive non-verbal stimuli.

Validity:

1. Criterion:

   (a) concurrent. With the Stanford-Binet administered at:

Months	N	r.
24	22	.53
27	41	.64
30	57	.47

   (b) predictive. Predictive validity of infant tests is generally low for later intelligence and achievement test scores because of the lower reliabilities of early infant assessments, plus the fact that early infant assessment samples different behaviors (non-verbal) than required on later intelligence and achievement tests. Validity coefficients increase as the infant tests sample more language skills, after about 18 months on the Bayley.

   One longitudinal study reported a r.=.44 and r. = .49 between several fine motor Bayley items assessed at 8 months, and results of 7 year Draw-a-person and Bender Gestalt tests. The items involved grasping cubes, crayons, etc. Correlations of 8 month Bayley Mental and Motor Scores with 7 year WBC. Verbal scores were .17 and .23 respectively, for 131 males, (Welcher, D. et al., 1971).

2. Content: not reported, but items appear to measure non-verbal skills which may relate to later cognitive development.

3. Construct: not reported, but items are passed by higher percentages of older children, and failed by a larger percent of younger children.

Bayley (cont.)

Reliability:

1. percent agreement on items scored:

   (a) tester-observer.

	MDI			PDI	
N	M	S.D.		M.	S.D.
90	89.4%	7.1%		93.4%	3.2%

   (b) Test-retest, one week.

	MDI			PDI	
N	M	S.D.		M.	S.D.
28	76.4%	13.7%		75.3%	14.5%

2. split-half (Spearman-Brown formula).

   (a) MDI - ranges from .81 to .93 with a median value of .88, across age ranges.

   (b) PDI - ranges from .68 to .92, with a median value of .84, across age ranges.

   (c) selected reliability coefficients (for comparison at same ages as Cattell Infant Scale).

Months	MDI	PDI
3	.93	.78
6	.92	.89
8	.81	.83
12	.82	.87
18	.89	.92
24	.89	.84
30	.86	.87

3. Stability: test-retest reliability coefficients.

   (not given in this manual)

Standard Error of Measurement:

MDI - ranges from 4.2 to 6.9, across ages.

PDI - ranges from 4.6 to 9.0, across ages.

Standardization:

- Based on 1960 U.S. Census data. The sample contains 1262 children, with 83 to 94 children at each of the following age levels, 2, 3, 4, 5, 6, 8, 10, 12, 15, 18, 21, 24, 27, 30.
- Data collected between 1958 and 1960 for half the children between 2 and 15 months of age. When other data collected is not indicated.
- Data represent U.S. Census data (1960) for race, sex, urban-rural, geographic location, and parent's occupation.

Bayley (cont.)

Standardization (cont.)

- "The children were located through hospitals, well baby clinics, pediatricians, municipal birth records, and social agencies. Only 'normal' children living at home were included in the sample and, with few exceptions, only one child per family was tested. Institutionalized children with severe behavioral or emotional problems, and those born more than one month prematurely were excluded, as were children from bilingual homes if they were over 12 months of age and showed noticeable difficulty in English." (Bayley, Manual, pp. 7-8.)

Comments:

1. "No significant differences were found on either the Mental or Motor Scale by sex, birth order, geographic location, or parent's education." The only significant difference by ethnic group was a consistent tendency for black children to obtain slightly superior scores on the Motor Scale at all ages from 3 through 14 months.

2. Test administrators must be thoroughly trained to administer and interpret this test. Examiner must have skill in establishing and maintaining rapport with babies, and evoking the best responses from them. The examiner should always rush herself, but rarely rush the baby.

3. This is an excellent infant scale. Its standardization and psychometric quality make it the only adequately normed standardized test of infant level mental and motor development.

4. Infant test scores lack adequate criterion validity to predict later intelligence and achievement test scores. They should be used to determine the infant's current level of functioning in relation to other babies, but not to predict future developmental trends. Welcher, et al. report correlations between Bayley Scores at 8 months and various tests administered at 4 and 7 years.

Name:	Infant Intelligence Scale (Cattell)
Author:	Psyche Cattell
Publisher:	The Psychological Corporation
Copyright:	1940 (The 1960 "revision" is identical to the 1940 version, except for minor corrections)
Administration:	Individual, 45-60 minutes.
Levels:	2-30 months.
Scores:	Global ratio (quotient) I.Q. M = 100 S.D. not given. Mental age.
Skills Tested:	General intellectual skills. Skills tested vary with age. In general, non-verbal and motor responses are stressed, to non-verbal and verbal stimuli. Requires child to follow verbal directions within the context of suggestive non-verbal stimuli.

Validity:

1. Criterion

   (a) concurrent. For "retarded" babies or babies with developmental problems, the Cattell correlated with the Bayley at r. = .97 (Erickson, Johnson and Campbell, 1970).

   (b) predictive: Cattell with 36 month Stanford-Binet, Form L (1937):

Month of Cattell examination	r. with Stanford-Binet at 36 months
3 mos.	r. = .10
6 mos.	r. = .34
9 mos.	r. = .18
12 mos.	r. = .56
18 mos.	r. = .67
24 mos.	r. = .71
30 mos.	r. = .83

   (c) Predictive validity of infant tests is generally low for later intelligence and school achievement test scores because of the low reliabilities of early infant assessments, plus the fact that early infant assessments sample different behaviors than those required on later intelligence and achievement tests (i.e., non-verbal vs. verbal samples). Validity coefficients increase as the amount of language sampled increases, after about 18 months on the Cattell.

Cattell (cont.)

2. Content: not addressed, but the items appear to be measuring non-verbal skills that could relate to intellectual development.

3. Construct: Not addressed.

Reliability:

1. Internal consistency (split half: Spearman-Brown formulas, corrected for test length)

Months	r.
3 mos.	.56
6 mos.	.88
9 mos.	.86
12 mos.	.89
18 mos.	.90
24 mos.	.85
30 mos.	.71

2. test-retest (not given)

3. percent agreement on items scored: (not given)

Standard Error of Measurement:

Not given, and cannot be estimated since the S.D. at each age level is not known.

Standardization:

Norms based on 1346 examinations made on 274 "normal" white, middle class children at these months of age: 3, 6, 9, 12, 18, 24, 30, 36. But the number of children at each age level varied greatly.

All children lived in the Boston, Massachusetts area, but the sample does not even represent that area at the time (1930-37).

Criteria for selection in sample:

(a) all evidence should point toward the normal delivery of a normal child.
(b) the father of the child should have employment which gave promise of permanence, and that he would be likely to reside near the Center for a number of years.
(c) at least three grandparents be of north European stock.
(d) the mother be able to give evidence of her ability and willingness to cooperate with the Center over a period of years.
(e) had to be enrolled in one of the clinics from which the sample was selected (Boston Lying-In Hospital). This criteria excluded mothers with incomes above a certain level. Also, an admittance fee of $50 (1930 dollars) was required for the clinic, thus excluding those who could not, or chose not to, afford it.

Cattell (cont.)

Comments:

1. The author states that the Cattell is "so constructed as to constitute an extension downward of Form L of the 1937 Stanford-Binet tests." But the test is an extension of the Stanford-Binet (1937) in form only, not in substance or validity.

2. While this test was well constructed for its time (1940), it would need to be restandardized according to current technical criteria to be useful as a psychometric test today.

3. The Bayley Scales would be a more appropriate choice than the Cattell for any assessment question that might be asked of either test today.

Name: Stanford-Binet Intelligence Scale (L-M)

Authors: Lewis Terman and Maud Merrill

Publisher: Houghton Mifflin Co.
Test Department
Box 1970
Iowa City, Iowa 52240

Copyright: 1960, renormed 1972

Administration: Individual, 30-90 minutes (depending on age and ability).

Levels: 2 years - adult

Scores: Mental Age, Deviation IQ

Skills Tested: General intellectual ability, skills tested vary with age. In general, verbal skills and responses are stressed except at early age levels where motor responses are stressed.

Validity: No data are presented regarding content and construct validity studies in the manual. It was assumed that since the basic content of the test did not change with the renorming, previous validity studies are applicable.

Waddell (1980) cited 11 studies which correlated the 1972 Binet intelligence scores with other intelligence scores and served as evidence for construct and content validity. However, no predictive validity studies are cited.

Reliability: No reliability data are presented in the manual to accompany the 1972 standardization. The authors assumed that because earlier editions were reliable, this one is too. No data are provided on the standard error of measurement.

Standardization: The 1972 edition is a renorming of the 1960 edition. N = about 2,100. However, a major difficulty with the 1972 standardization is an inadequate description of the sample in the manual. The following comments address standardization issues:

a. Based on the manual, "one can not determine if the 1972 standardization sample adequately represents the school-aged population in terms of race, ethnic group, socio-economic status or size and type of community." (Waddell, 1980).

b. Number of children tested at each age level varied considerably. The range was from 43 at age 2-0 to 150 at age 7-0 with a mean of 112 per age level.

c. Children whose primary home language was not English were excluded from the sample.

Comments:

- Stanford-Binet was designed as a test of general intellectual ability, not as a differential measure of several aspects of mental ability. Therefore, attempts at profiles of subtest performance may yield questionable results.

- The 1972 norms do not include a table, like that available with the 1960 norms, which transformed obtained ratio IQ scores into deviation IQ scores. Items are no longer "age-placed" appropriately. Research (Salvia, Ysseldyke and Lee, 1975) has demonstrated that a child must score a mental age of 4-6 if chronologically 4-0 to obtain an IQ of 100. Therefore, care must be taken when interpreting mental age scores because of the relationship between IQ and mental age on the 1972 norms.

- "Although the Stanford-Binet has often been acclaimed as <u>the</u> intelligence test, the most recent edition of the test has questionable merit...In our opinion, the authors of the Stanford-Binet need to provide sufficient data about the new edition in order to provide sufficient data about the new edition in order to warrant the continued faith that professionals place in this device." (Salvia and Ysseldyke, 1978) (p. 234).

Name:	Wechsler Intelligence Scale for Children - Revised
Author:	David Wechsler
Publisher:	The Psychological Corporation 757 Third Avenue New York, NY 10017
Copyright:	1974
Administration:	Individual, 50-75 minutes
Levels:	6-0 to 16-11
Scores:	Scaled scores, deviation IQ's, "test age"
Skills Tested:	Verbal Scale: Information, Similarities, Arithmetic, Vocabulary, Comprehension, Digit Span. Performance Scale: Picture Completion, Picture Arrangement, Block Design, Object Assembly, Coding, Mazes.
Validity:	Concurrent: 1. With WPPSI (N=50, ages about 6-0), r=.82. Full Scale IQ, r=.74, Performance IQ; r=.78, Verbal IQ. 2. With WAIS (N=40, ages about 16-11), r=.95 Full Scale; .96 Verbal; .83 Performance. 3. With Stanford-Binet (N=50, age 6; 29 at 9-1/2, 27 at 12-1/2, 29 at 16-1/2) Full Scale IQ, r's = .63-.82.
Reliability:	Test-Retest: (N=303, from 6 age groups combined for 3 analyses) interval of about 1 month. Verbal IQ (r's = .90, .89, .90); Full Scale IQ (r's = .94, .95, .95); Subtests: range from .50 to .90. Internal Consistency: (split-half) (N=200 for each age group) Verbal IQ, r's = .91-.96; Performance IQ, r's = .89-.91; Full Scale IQ, r's = .95-.96; Subtests, r's vary ranging from .57-.92. SEM: Individual subtests (Scaled Scores units) - vary with age, range .87-1.98. IQ units: vary with age, Verbal IQ, 3.13-4.08; Performance IQ, 4.39-4.96; Full Scale IQ, 2.96-3.41.
Standardization:	N=2,200, 200 in each of 11 age groups from 6-1/2 to 16-1/2; 100 boys, 100 girls at each level; stratified according to 1970 census data with respect to race, geographic region, urban-rural residers, occupation of head of household.

Comments:

- Discussion of validity lacks factor analytic data.
- No research data presented on whether or not subtest scores can be used for diagnostic purposes.
- SEM data are not given for lower IQ ranges (70-79) (80-89) where crucial decisions are made.

Name: Wechsler Preschool and Primary Scale of Intelligence (WPPSI)

Author: David Wechsler

Publisher: The Psychological Corporation
757 Third Avenue
New York, NY 10017

Copyright: 1963, 1967

Administration: Individual. Manual states that some children will need two sessions for the test. In the standardization sample about 10% needed one and one-half hours or more to complete the test. May be unduly long for some.

Levels: Ages 3 years, 10 months, to 6 years, 7 months.

Scores: Scaled scores, deviation IQ's. Also able to obtain "equivalent MA's" on "test ages."

Skills Tested: Verbal Scale: Information, Vocabulary, Arithmetic, Similarities, Comprehension, Sentences.

Performance Scale: Animal House, Picture Completion, Mazes, Geometric Design, Block Design.

Validity: The only validity data reported in the manual were obtained by administering the WPPSI, Stanford-Binet, Peabody Picture Vocabulary Test and Pictorial Test of Intelligence to 98 children in a single school district.

All means were within 4 points of each other. Correlations for WPPSI Full Scale IQ ranged from .58 (PPVT) to .75 (S-B). Subsequent studies generally report higher mean scores on the S-B than on the WPPSI.

Reliability: Test-Retest: r=.86, .89, .92 for Verbal, Performance and Full Scale IQ's respectively, 11-week interval (N=50, ages about 5-1/2 years).

Subtest Reliabilities: 10 of 11 less than .80, 5 of 11 below .70.

Internal-Consistency: (split-half) (standardization sample). Verbal: .93-.94; Performance: .91-.95; Full Scale: .96-.97. Subtests: .62-.88; SEM: Individual subtests (Scale Score units): .87-1.87 IQ units; Verbal: 3.40-3.69; Performance IQ: 3.44-4.35; Full Scale: 2.66-3.12.

Standardization: (N=1200). Sample of 100 boys and 100 girls in six age groups, ranging by half-years from 4.0 through 6.5 years.

Sample was stratified with respect to geographic region, urban-rural, father's occupation and race (white versus nonwhite) based on 1960 census. Nonwhites make up 14% of the standardization sample.

Comments:

- Manual recommends that IQ's not be calculated unless a child obtains raw scores greater than zero on at least two verbal and two performance subtests.
- WPPSI appears to suffer from inadequate floor to differentiate abilities at the lower end of the scale. A four year old making no correct responses would obtain a Verbal IQ of 56, Performance IQ of 57 and Full Scale IQ of 53.
- Test may be too difficult for four year olds with IQ's below 75.
- Manual has a table showing the critical values of differences between scaled scores on all possible pairs of subtests. Another table shows the critical value of differences between Verbal and Performance IQ's.
- Examiner is instructed to request an additional response when it is not spontaneously given. Tends to de-emphasize response style.

APPENDIX J

EXTENDED TABLES

Table J1: Intermediate school district special education incidence, grades 2 through 8 (Eaton, Clinton, Shiawassee, and Ingham ISDs).

	Grade							2 to 8 Ave.
	2	3	4	5	6	7	8	
Eaton ISD								
POHI	.0009	.005	.003	.009	.0025	.0036	.0017	.0025
HI	0	.0008	0	.0017	0	0	.0017	.0005
SXI	.0009	.002	.004	.0017	.0008	.0009	0	.0015
EMI	.008	.006	.005	.0025	.0042	.0044	.0095	.0057
LD	.007	.03	.069	.064	.063	.067	.057	.051
SLI	.04	.03	.042	.021	.015	.008	.0043	.023
EI	.003	.002	.011	.021	.015	.020	.022	.013
Total	.06	.077	.139	.114	.100	.098	.097	.098
Clinton ISD								
POHI	.0016	.0015	0	.0016	.005	0	.0015	.0016
HI	.0016	0	.0035	0	0	0	0	.0007
SXI	.0032	0	0	.0016	.0017	.0013	.0015	.0013
EMI	.0097	.0046	.0053	.0048	.0084	.0093	.016	.0083
LD	.024	.063	.081	.084	.087	.056	.076	.067
SLI	.073	.085	.067	.016	.015	.004	.0045	.038
EI	.015	.018	.021	.024	.022	.020	.027	.021
Total	.127	.171	.161	.154	.139	.089	.131	.139
Shiawassee ISD								
POHI	.0029	.003	.0028	.0035	.0009	.0009	.0009	.0021
HI	.0009	.001	.0009	.0026	.0009	.0009	0	.001
SXI	0	.002	.0019	0	.0009	0	0	.0007
EMI	.0077	.008	.011	.011	.009	.0054	.01	.0089
LD	.013	.022	.036	.040	.064	.040	.054	.038
SLI	.090	.072	.031	.025	.017	.0045	.0009	.034
EI	.0058	.017	.013	.013	.021	.019	.023	.016
Total	.120	.125	.105	.096	.114	.071	.089	.103
Ingham ISD								
POHI	.0054	.0036	.0057	.004	.0032	.0026	.0023	.0038
HI	.0036	.002	.0033	.002	.0035	.0043	.0026	.003
SXI	.0027	.0005	.0018	.0019	.0013	.0008	.0015	.0015
EMI	.0056	.0059	.0087	.009	.0088	.0066	.0076	.0075
LD	.016	.037	.050	.063	.068	.070	.069	.053
SLI	.029	.041	.043	.031	.018	.011	.009	.026
EI	.0046	.010	.011	.017	.019	.022	.020	.015
Total	.067	.100	.099	.122	.122	.117	.113	.106

Key: POHI = Physically or otherwise health impaired
SXI = Severely multiply impaired
EMI = Educable mentally impaired
SLI = Speech and language impaired
HI = Hearing impaired
LD = Learning disabled
EI = Emotionally impaired

Table J2: Mid-Michigan ISD special education incidence, by gender.

	Grade							2 to 8 Ave.
	2	3	4	5	6	7	8	
Males								
POHI	.001	.001	.002	.001	.001	.001	.001	.0011
HI	.001	.001	.001	.001	.001	.001	.001	.001
SXI	.001	.0004	.001	.001	.001	.0003	.0005	.0007
EMI	.004	.003	.005	.005	.005	.004	.004	.0043
LD	.011	.025	.038	.043	.047	.043	.046	.036
SLI	.029	.032	.025	.020	.011	.005	.004	.018
EI	.004	.008	.010	.014	.014	.016	.017	.012
Total	.050	.0694	.080	.084	.079	.0693	.0725	.072
Females								
POHI	.001	.001	.002	.001	.001	.001	.001	.0011
HI	.001	.001	.001	.001	.001	.002	.001	.0011
SXI	.001	.0004	.001	.001	.001	.0005	.0005	.0008
EMI	.002	.003	.004	.003	.003	.003	.006	.0034
LD	.003	.011	.017	.019	.021	.019	.019	.016
SLI	.016	.016	.018	.009	.006	.003	.003	.010
EI	.002	.003	.002	.004	.005	.004	.005	.0036
Total	.026	.0354	.045	.038	.038	.0325	.0325	.035

Table J3: PTAGA special services.

Subject	Birth Date	Gender	Elig. = Sp. Serv.	Program	Suppl. Serv.	Initial Referral
1	2-80	F	Sp.Ed./POHI	POHI Rm.	PT/SLT	81
2	1-80	M	Sp.Ed./POHI	PPI/POHI	OT/PT/SLT	80
3	4-81	M	Sp.Ed./POHI	PPI/Res. Rm.	OT/PT	1-83
4	3-82	M	Sp.Ed./POHI	PPI/POHI/ Res. Rm.	OT/PT/SLT	84
5	8-82	M	Sp.Ed./SXI	PPI/SXI	OT/PT/SLT	84
6	1-83	F	Sp.Ed./SXI	PPI/SXI	OT/PT/SLT	87
7	10-79	M	Sp.Ed./LD	Res. Rm.		3-88
8	10-79	M	Sp.Ed./LD	Res. Rm.		8-87
9	6-79	F	Rem. Rdg. Sp.Ed./LD	Res. Rm.		84/86 1-85
10	12-79	M	Sp.Ed./LD	PPI/Res. Rm.		2-86
11	7-82	M	Rem. Rdg. & Math Sp.Ed./LD	 Res. Rm.		89-90 3-90
12	4-82	M	Sp.Ed./EI	Res. Rm.	SSW	3-90
13	4-79	M	Rem. Rdg.			85-86
14	5-80	M	Rem. Math			89-90
15	11-81	F	Rem. Rdg.			89
16	7-82	M	Rem. Rdg.			89-90

	Number	Percent
In special education	12	28.6
In remedial programs	6	14.3
In special programs	16	38.1
Not in special programs	26	61.9

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Table J4: PTSGA special services.

Subject	Birth Date	Gender	Elig. = Sp. Serv.	Program	Suppl. Serv.	Gd./Yr. Init.Ref.
1	4-78	M	Sp.Ed./SXI	PPI/SXI	OT/PT	79
2	3-79	M	Sp.Ed./EMI	PPI/Res. Rm.		83
3	12-79	M	Sp.Ed./LD	Res. Rm.		3-83
4	12-79	M	Sp.Ed./LD	PPI/Res. Rm.	SSW	K-84
5	12-80	M	Sp.Ed./SLI	SLT		3-89
6	12-79	M	Headstart			84
7	12-77	M	Rem. Rdg.			84
8	4-82	M	Rem. Rdg.			88
9	4-83	F	Rem. Rdg.			91
10	3-81	M	Sp.Ed./SLI	SLT		83 DK/84
11	4-82	M	Sp.Ed./SLI	SLT		84 DK/87

	No.	%		No.	%
In special education	5	19.2	In special programs	11	42.3
In remedial programs	3	11.5	Not in spec. programs	15	57.7

Table J5: FTSGA special services.

Subject	Birth Date	Gender	Elig. = Sp. Serv.	Program	Suppl. Serv.	Gd./Yr. Init.Ref.
1	11-83	F	Sp.Ed./HI	PPI/HI		86
2	5-78	M	Sp.Ed./SXI	SXI	VI/TC	79
3	9-79	F	Sp.Ed./LD Headstart	Res. Rm.	SSW	2-86 83
4	2-82	M	Sp.Ed./SLI	SLT		86
5	5-78	F	Rem. Rdg.			84/85
6	6-80	M	Sp.Ed./SLI	PPI		83 DK/85

	No.	%		No.	%
In special education	4	28.6	In special programs	6	42.9
In remedial programs	1	7.1	Not in spec. programs	8	57.1

Table

Table J6: Number of special education students by diagnostic category and by age: Michigan audited report for 1989.

STATE 1989		EDUC MENT IMP	TRAIN MENT IMP	SEV MENT IMP	EMO TION ALLY IMP	LEARN ING DIS	HEAR ING IMP	VIS UAL LY IMP	PHYS OTHER HLTH IMP	SEV MULT IMP	SP & LANG IMP	PRE PRIM IMP	AUT ISTIC IMP	TOTAL BY AGE
TOTAL														
0-2 YRS	0 YRS	24	1	6	9	43	10	5	126	27	61	68	0	380
	1 YR	39	11	23	3	8	31	24	317	95	26	132	1	760
	2 YRS	66	36	44	6	7	63	35	392	143	309	264	4	1,369
SUBTOTAL		129	48	73	18	58	104	64	835	265	396	514	5	2,509
3-5 YRS	3 YRS	140	87	51	44	11	96	34	346	161	1297	481	18	2,766
	4 YRS	171	96	58	97	60	117	35	342	154	2706	700	34	4,570
	5 YRS	256	170	47	198	174	141	43	334	151	4997	417	49	6,977
SUBTOTAL		567	353	156	339	245	354	112	1022	466	9000	1598	101	14,313
6-11 YRS	6 YRS	466	196	84	299	678	138	44	338	154	6119	37	65	8,618
	7 YRS	748	248	77	539	1962	174	64	332	147	6518	3	51	10,863
	8 YRS	889	226	79	924	4244	205	44	371	131	6309	2	59	13,483
	9 YRS	999	258	98	1187	6090	191	82	312	137	5012	0	66	14,432
	10 YRS	1045	267	104	1568	7121	220	51	335	134	3481	0	65	14,391
	11 YRS	1030	272	67	1679	7188	211	54	287	134	2094	0	50	13,066
SUBTOTAL		5177	1467	509	6196	27283	1139	339	1975	837	29533	42	356	74,853
12-17 YRS	12 YRS	1003	271	97	1900	7293	190	49	286	113	1229	0	53	12,484
	13 YRS	942	300	89	2045	6706	176	61	265	107	718	1	61	11,471
	14 YRS	963	299	81	2172	6652	172	59	226	99	447	0	60	11,230
	15 YRS	1065	280	92	2261	6185	188	32	220	115	341	0	60	10,839
	16 YRS	948	307	114	1883	5613	186	47	207	95	189	1	42	9,632
	17 YRS	864	319	96	1322	4695	155	56	235	103	166	0	51	8,062
SUBTOTAL		5785	1776	569	11583	37144	1067	304	1439	632	3090	2	327	63,718
18-21 YRS	18 YRS	791	337	95	705	3180	125	39	168	86	82	0	41	5,649
	19 YRS	438	352	105	196	725	36	19	102	87	21	0	42	2,123
	20 YRS	237	310	111	58	165	13	13	41	59	4	1	40	1,052
	21 YRS	189	321	132	52	55	9	4	42	78	1	0	26	909
SUBTOTAL		1655	1320	443	1011	4125	183	75	353	310	109	1	149	9,733
22 PLUS	22 YRS	159	293	130	44	60	5	4	34	67	2	0	30	828
	23 YRS	166	314	130	37	46	5	1	32	82	0	0	27	840
	24 YRS	153	318	166	35	41	9	1	32	90	1	0	29	875
	25 YRS	166	393	187	47	67	5	6	33	89	1	0	36	1,030
	26 YRS	0	1	0	0	0	0	0	0	0	0	0	0	1
SUBTOTAL		644	1319	613	163	214	24	12	131	328	4	0	122	3,574
TOTAL		13957	6283	2363	19310	69069	2871	906	5755	2838	42131	2157	1060	168,700
PERCENT		8.27	3.72	1.40	11.45	40.94	1.70	.54	3.41	1.68	24.97	1.28	.63	100.00

Table J7: PTSGA total sample LD discrepancies.

	Standard Score Discrep.		Regression Analysis Discrep.		Regres. Diff.
	Subject	LD Areas	Subject	LD Areas	
18 pts.	8	6,7	8	5,6,7	0
	9	1,2,4,5,6,7	9	4,5,7	
	*10	1,2,3	*10	1,2,3	
	19	6	19	6	
	22	5	4	3	
	23	5,6,7	23	5,6,7	
	16 areas/ave. 2.67		14 areas/ave. 2.33		
20 pts.	8	6,7	8	5,6,7	0
	9	1,2,4,5,6,7	9	4,5,7	
	*10	1,2,3	*10	1,2,3	
	19	6	19	6	
	22	5	4	3	
	23	5,6,7	23	5,6,7	
	16 areas/ave. 2.67		14 areas/ave. 2.33		
24 pts.	8	6,7	8	6,7	+3.9%
	9	2,4,5,6,7	9	4,5	
	*10	3	*10	1,2,3	
			23	5,6,7	
	8 areas/ave. 2.67		10 areas/ave. 2.5		

Key:
1 = Reading Total
2 = Reading Recognition
3 = Reading Comprehension
4 = Spelling & Written Language
5 = Math Computation
6 = Math Application/Concepts
7 = Math Total
* = IEPC/LD

Table J8: FTSGA total sample LD discrepancies.

	Standard Score Discrep.		Regression Analysis Discrep.		Regres. Diff.
	Subject	LD Areas	Subject	LD Areas	
18 pts.	7 8 9 11	2,4 3 1,2,4,5,7 1,2,4,6	7 8 9 11	4 3 1,2,4,5,7 2,4,6	0
	12 areas/ave. 3.0		10 areas/ave. 2.5		
20 pts.	7 8 9 11	4 3 4 2,4,6	 8 9 11	 3 1,2,4,5,7 2,6	-7.2%
	6 areas/ave. 1.5		8 areas/ave. 2.67		
24 pts.	9 11	4 2,6	9 11	3 6	0
	3 areas/ave. 1.5		2 areas/ave. 1.0		

Key:
1 = Reading Total
2 = Reading Recognition
3 = Reading Comprehension
4 = Spelling & Written Language
5 = Math Computation
6 = Math Application/Concepts
7 = Math Total
* = IEPC/LD

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Table J9: PTAGA total sample LD discrepancies.

	Standard Score Discrep.		Regression Analysis Discrep.		Regres. Diff.
	Subject	LD Areas	Subject	LD Areas	
18 pts.	*3	1,2,3,4,5	*3	1,2,3,4,5	0
	*4	1,3	*4	1,3,4	
	6	1,7	6	1,7	
	7	1,2,3,4,5	7	4,5	
	8	2,4	*34	1	
	14	4,5,6,7	14	4,5	
	*21	5	*21	1,2,5	
	24	1,3,4	41	1,2,3,4,5,6,7	
	39	4	39	4	
	40	4,7	40	4,7	
	27 areas/ave. 2.7		28 areas/ave. 2.8		
20 pts.	*3	1,2,3,4,5	*3	1,2,3,4,5	-4.7%
	*4	1,3	*4	1,3,4	
	6	7	6	1,7	
	7	1,2,3,4,5	7	4,5	
	8	4			
	14	4,5,6,7			
	*21	5	*21	2,5	
	24	3,4	41	1,2,3,4,5,6,7	
	39	4	39	4	
	40	7	40	4,7	
	23 areas/ave. 2.3		24 areas/ave. 3.0		
24 pts.	*3	2,3	*3	1,2,3	-2.3%
	*4	1	*4	1,3,4	
	7	4,5	7	4	
	*21	5	*21	2,5	
	24	3,4	41	1,2,3,4,5,6,7	
	39	4			
	40	4	40	7	
	6	7	6	7	
	11 areas/ave. 1.375		18 areas/ave. 2.57		

Key:
1 = Reading Total
2 = Reading Recognition
3 = Reading Comprehension
4 = Spelling & Written Language
5 = Math Computation
6 = Math Application/Concepts
7 = Math Total
* = IEPC/LD

Table J10: Matched PTSGA/PTAGA LD discrepancies--Standard score method.

Std. Score Discrep.	PTSGA		PTAGA Matches		SGA Diff.
	Subject	Areas	Subject	Areas	
18 pts.	5	6,7	1	1,3,4,5,6,7	+4.6%
	6	1,2,4,5,6,7	4	3,4,5,6,7	
	7	2,3	7	1,3	
	15	6	10	2,5	
	19	2,3	22	5	
	20	5,6,7			
	Total 6 (27.3%) 27 areas/ave. 2.66		Total 5 (22.7%) 16 areas/ave. 3.2		
20 pts.	5	6,7	1	3,4	+4.5%
	6	1,2,4,5,6,7	4	4,5,6,7	
	7	2,3	7	1,3	
	15	6	10	5	
	19	3			
	Total 5 (22.7%) 12 areas/ave. 2.4		Total 4 (18.2%) 9 areas/ave. 2.25		
24 pts.	5	6,7	1	3,4	+4.6%
	6	2,4,5,6,7	7	3	
	7	3	10	5	
	19	3			
	Total 4 (18.2%) 9 areas/ave. 2.24		Total 3 (13.6%) 4 areas/ave. 1.33		

Key:
1 = Reading Total
2 = Reading Recognition
3 = Reading Comprehension
4 = Spelling & Written Language
5 = Math Computation
6 = Math Application/Concepts
7 = Math Total

Table J11: Matched PTSGA/PTAGA LD discrepancies--Regression analysis method.

Std. Score Discrep.	PTSGA		PTAGA Matches		SGA Diff.
	Subject	Areas	Subject	Areas	
18 pts.	5 6 7 15 20	5,6,7 4,5,7 2,3 6 5,6,7	4 7 10 3	4,6 1,3 2,5	+9.1%
	Total 5 (22.7%) 12 areas/ave. 2.4		Total 3 (13.6%) 6 areas/ave. 2.0		
20 pts.	5 6 7 15 20	5,6,7 4,5,7 2,3 6 5,6,7	7 10	1,3 2,5	+13.6%
	Total 5 (22.7%) 12 areas/ave. 2.4		Total 2 (9.1%) 4 areas/ave. 2.0		
24 pts.	5 6 7 20	6,7 4,5 2,3 5,6,7	7 10 2	1,3 2,5	+9.1%
	Total 4 (18.2%) 9 areas/ave. 2.25		Total 2 (9.1%) 4 areas/ave. 2.0		

Key:
1 = Reading Total
2 = Reading Recognition
3 = Reading Comprehension
4 = Spelling & Written Language
5 = Math Computation
6 = Math Application/Concepts
7 = Math Total

Table J12: Matched FTSGA/PTAGA LD discrepancies--Standard score method.

Std. Score Discrep.	FTSGA		PTAGA Matches		SGA Diff.
	Subject	Areas	Subject	Areas	
18 pts.	4 5 6 7	2,4 3 2,4,5 1,2,4,6	4 8	1,3,4,6 1	+18.2%
	Total 4 (36.4%) 10 areas/ave. 2.5		Total 2 (18.2%) 5 areas/ave. 2.5		
20 pts.	4 5 6 7	4 3 4 2,4,6	4 8	3,4 1	+18.2%
	Total 4 (36.4%) 6 areas/ave. 1.5		Total 2 (18.2%) 3 areas/ave. 1.5		
24 pts.	7	2,6	4	3,4	0
	Total 1 (9.1%) 2 areas/ave. 2.0		Total 1 (9.1%) 2 areas/ave. 2.0		

Key:
1 = Reading Total
2 = Reading Recognition
3 = Reading Comprehension
4 = Spelling & Written Language
5 = Math Computation
6 = Math Application/Concepts
7 = Math Total

Table J13: Matched FTSGA/PTAGA LD discrepancies--Regression analysis method.

Std. Score Discrep.	FTSGA		PTAGA Matches		SGA Diff.
	Subject	Areas	Subject	Areas	
18 pts.	4 5 6 7	4 3 2,4,5 2,4,6	8	1	+27.3%
	Total 4 (36.4%) 8 areas/ave. 2.0		Total 1 (9.1%) 1 area/ave. 1.0		
20 pts.	5 6 7	3 2,4,5 2,6	8	1	+18.2%
	Total 3 (27.3%) 6 areas/ave. 2.0		Total 1 (19.0%) 1 area/ave. 1.0		
24 pts.	6 7	4 6	8	1	+ 9.1%
	Total 2 (18.2%) 2 areas/ave. 1.0		Total 1 (9.1%) 1 area/ave. 1.0		

Key:
1 = Reading Total
2 = Reading Recognition
3 = Reading Comprehension
4 = Spelling & Written Language
5 = Math Computation
6 = Math Application/Concepts
7 = Math Total

Key

Table J14: Higher versus lower SES LD discrepancies.

Standard Score Discrep.	Low SES		High SES	
	Subject	LD Areas	Subject	LD Areas
18 pts.	2 7 8	2,5 1,2,4,5,6,7 6	1	1,7
	Total 3 (37.5%) 9 areas/ave. 2.0		Total 1 (12.5%) 2 areas/ave. 2.0	
20 pts.	2 7 8	5 1,2,4,5,6,7 6	1	7
	Total 3 (37.5%) 8 areas/ave. 2.67		Total 1 (12.5%) 1 area/ave. 1.0	
24 pts.	2 7	5 1,2,4,5,6,7		
	Total 2 (25%) 7 areas/ave. 3.5		Total 0	

Regression Analysis Discrep.	Low SES		High SES	
	Subject	LD Areas	Subject	LD Areas
18 pts.	2 7 8	1,2,5 4,5,7 6	1	1,7
	Total 3 (37.5%) 7 areas/ave. 2.33		Total 1 (12.5%) 1 area/ave. 2.0	
20 pts.	2 7 8	2,5 4,5,7 6	1	1,7
	Total 3 (37.5%) 6 areas/ave. 2.0		Total 1 (12.5%) 1 area/ave. 2.0	
24 pts.	2 7	2,5 4,5	1	7
	Total 2 (25%) 4 areas/ave. 2.0		Total 1 (12.5%) 1 area/ave. 1.0	

Key: 1 = Reading Total
2 = Reading Recognition
3 = Reading Comprehension
4 = Spelling & Written Language
5 = Math Computation
6 = Math Application/Concepts
7 = Math Total

Table J15: Psychometric ability/achievement discrepancies in IEPC identified LD subjects.

Std. Score Discrep.	Pair	At-Risk LD	Local LD	Regress. Analysis Discrep.	Pair	At-Risk LD	Local LD
		LD Areas	LD Areas			LD Areas	LD Areas
18 pts.	1	1,2,3,4	3,4	18 pts.	1	1,2,3,4	3,4
	2		4		2	2	4
	3		1,4,5		3		1,2,3,4,5
	4	3			4	3	
	5	2,3			5	2,5	4
	6	1,2,3,4			6	1,2,3,4,5	3
	7	4,5	1,4		7	4,5	1,4
	8		1,2,3,4,5		8	3,4	1,2,3,4,5
	Total	5 (62.5%) 13 areas/ 2.6 ave.	5 (62.5%) 13 areas/ 2.6 ave.		Total	7 (87.5%) 17 areas/ 2.43 ave.	7 (87.5%) 17 areas/ 2.43 ave.
20 pts.	1	1,2,3	3	20 pts.	1	1,2,3,4	3,4
	2		4		2		4
	3		1,4,5		3		1,4,5
	4	3			4	3	
	5	2,3			5	2,5	
	6	1,2,3,4			6	1,2,3,4,5	
	7	4,5	1,4		7	4,5	1,4
	8		1,2,3,4,5		8	3,4	1,2,3,4,5
	Total	5 (62.5%) 12 areas/ 2.4 ave.	5 (62.5%) 12 areas/ 2.4 ave.		Total	6 (75%) 16 areas/ 2.67 ave.	5 (62.5%) 13 areas/ 2.6 ave.
24 pts.	1	1,2,3	3	24 pts.	1	1,2,3	3
	2		4		2		4
	3		4,5		3		1,4,5
	4				4	3	
	5	2,3			5	2,5	
	6				6	1,2,3,4	
	7		1		7		1
	8		1,2,3,5		8	3,4	1,2,3,4,5
	Total	2 (25%) 5 areas/ 2.5 ave.	5 (62.5%) 9 areas/ 1.8 ave.		Total	5 (62.5%) 12 areas/ 2.4 ave.	5 (62.5%) 11 areas/ 2.2 ave.

Key:
1 = Reading Recognition
2 = Reading Comprehension
3 = Reading Total
4 = Written Language
5 = Math Computation
6 = Math Reasoning

LIST OF REFERENCES

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Adamson, W. C., & Adamson, K. K. (1978). A handbook for specific learning disabilities. New York: Gardner Press.

Adelman, H. S., & Taylor, L. (1983). Learning disabilities in perspective. Glenview, IL: Scott, Foresman.

Alessi, G., & Lesiak, W. J. (1981). In J. H. Braccio (Ed.), Non-biased assessment of high incidence special education students. Lansing: Michigan Department of Education Special Services Area.

Allen, M. C. (1984). Developmental outcome and follow-up of the small for gestational age infant. Seminars in Perinatology, 8, 123-156.

Aman, M. G., & Singh, N. N. (1983). Specific reading disorders: Concepts of etiology reconsidered. Advances in Learning and Behavioral Disabilities, 2, 1-47.

Balow, B., Rubin, R., & Rosen, M. J. (1975). Perinatal events as precursors of reading disability. Reading Research Quarterly, 1, 36-71.

Beck, R. A. (1984). An evaluation of procedures for computing an ability-achievement discrepancy score. Journal of Learning Disabilities, 17, 262-266.

Behrman, R. E., Vaughan, N. M., & Nelson, W. E. (1983). Nelson textbook of pediatrics (12th ed.). Philadelphia: W. B. Saunders.

Blackman, J. A. (1984). Low birth weight. In J. A. Blackman (Ed.), Medical aspects of developmental disabilities in children birth to three. Rockville, MD: Aspen Publishers.

Broman, S. H., Nichols, P. L., & Kennedy, W. A. (1975). Preschool IQ. New York: Halsted.

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Caputo, D. V., & Mandell, W. (1970). Consequences of low birth weight. Developmental Psychology, 3, 363-383.

Children's Defense Fund. (1991). Child poverty in America. Washington, DC: Author.

Clarizio, H. F., & McCoy, G. F. (1983). Behavior disorders in children (3rd ed.). New York: Harper & Row.

Cohen, S. E. (1986). The low birthweight infant and learning disabilities. In M. Lewis (Ed.), Learning disabilities and prenatal risk. Urbana: University of Illinois Press.

Coles, G. S. (1987). The learning mystique: A critical look at "learning disabilities. New York: Pantheon Books.

Cone, T. E., & Wilson, L. R. (1981). Quantifying a severe discrepancy: A critical analysis. Learning Disability Quarterly, 4, 359-371.

D'Amato, R. C., Dean, R. S., Rattan, G., & Nickell, K. A. (1988). A study of referrals for learning disabled children. Journal of Psychoeducational Assessment, 6, 118-124.

Davie, R., Butler, N., & Goldstein, H. (1972). From birth to seven. A report of the National Child Development Study. London: Longman.

Dore-Boyce, K., Misner, M., & McGuire, D. (1975). Comparing reading expectancy formulas. The Reading Teacher, 29, 8-14.

Drillien, C. M. (1964). The growth and development of the prematurely born infant. Edinburgh: Livingstone.

Drillien, C. M. (1970). The small for date infant: Etiology and prognosis. Pediatric Clinics of North America, 17, 9-24.

Drillien, C. M., Thomson, A. F. M., & Burgoyne, K. (1980). Low birthweight children early school age: A longitudinal study. Developmental Medicine and Child Neurology, 22, 26-47.

Dubowitz, L. M. S., Dubowitz, V., & Goldberg, C. (1970). Clinical assessment of gestational age in the newborn infant. Journal of Pediatrics, 77, 1-10.

Dunn, H. G. (Ed.). (1986). Sequelae of low birthweight: The Vancouver study (Clinics in Developmental Medicine No. 95/96). Philadelphia: J. B. Lippincott.

Eaves, L. C., Nuttall, J. C., Klonoff, H., & Dunn, H. G. (1970). Developmental and psychological test scores in children of low birth weight. Pediatrics, 45, 9-20.

Epps, S., Ysseldyke, J. E., & McGue, M. (1984). "I know one when I see one." Differentiating LD and non-LD students. Learning Disabilities Quarterly, 7, 89-101.

Escalona, S. K. (1982). Babies at double hazard: Early development of infants at biologic and social risk. Pediatrics, 70, 670-676.

Fitzhardinge, P. M. (1976). Follow-up studies on the low birth weight infant. Clinics in Perinatology, 3, 503-516.

Fitzhardinge, P. M., Kalman, E., Ashby, S., & Pape, K. E. (1978). Present status of the infant of very low birth weight treated in a referral neonatal intensive care unit in 1974. Ciba Foundation Symposium of Major Mental Handicaps: Methods and Costs of Prevention, 59, 139-150.

Fitzhardinge, P. M., & Steven, E. M. (1972). The small for date infant. II. Neurological and intellectual sequelae. Pediatrics, 50, 50-57.

Francis-Williams, J., & Davies, P. A. (1974). Very low birthweight and later intelligence. Developmental Medicine and Child Neurology, 16, 709-728.

Frankenberger, W., & Fronzaglio, K. (1991). A review of states' criteria and procedures for identifying children with learning disabilities. Journal of Learning Disabilities, 24, 495-500.

Frankenberger, W., & Harper, J. (1987). States' criteria and procedures for identifying learning disabled children: A comparison of 1981/82 and 1985/86 guidelines. Journal of Learning Disabilities, 20, 118-121.

Gelb, S. A., & Mizokawa, D. T. (1986). Special education and social structure: The commonality of "exceptionality." American Educational Research Journal, 23, 543-557.

Gelfand, D. M., Jenson, W. R., & Drew, C. J. (1982). Understanding child behavior disorders. New York: Holt, Rinehart & Winston.

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Gjessing, H., & Karlsen, B. (1989). A longitudinal study of dyslexia. New York: Springer-Verlag.

Grossman, F. M. (Ed.). (1983). Classification in mental retardation. Washington, DC: American Association on Mental Deficiency.

Hack, M., Fanaroff, A. A., & Merkatz, I. R. (1979). The low-birth-weight infant: Evolution of a changing outlook. The New England Journal of Medicine, 301, 1162-1165.

Hammill, D. D. (1990). On defining learning disabilities: An emerging consensus. Journal of Learning Disabilities, 23, 74-84.

Harvey, D., Prince, J., Bunton, J., Parkinson, C., & Campbell, S. (1982). Abilities of children who were small for gestational age babies. Pediatrics, 69, 296-300.

Healy, A. (1983). The needs of children with disabilities: A comprehensive view. Ames: University of Iowa Press.

Hill, R. M., Verniaud, W. M., Deter, R. L., Tennyson, L. M., Rettig, G. M., Zion, T. E., Vorderman, A. L., Helms, P. G., McCulley, L. B., & Hill, L. L. (1984). The effect of intrauterine malnutrition on the term infant. Acta Paediatrica Scandinavia, 73, 482-487.

Hoffman, H. J., & Bakketeig, L. S. (1984). Heterogeneity of intrauterine growth retardation and recurrence risks. Seminars in Perinatology, 8, 15-24.

Hollingshead, A. B. (1975). Four factor index of social status. New Haven, CT: Yale University Press.

Hunt, J. V. (1986). Developmental risk in infants. Advances in Special Education, 5, 25-59.

Hunt, J. V., Cooper, B., & Tooley, W. H. (1988). Very low birth weight infants at 8 and 11 years of age: Role of neonatal illness and family status. Pediatrics, 82, 596-603.

Kalmar, M., & Boronkai, J. (1991). Interplay of biological and social-environmental factors in the developmental outcome of prematurely born children from infancy to seven years. International Journal of Disability, Development and Education, 38, 247-270.

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Kawi, A. A., & Pasamanick, B. (1959). Prenatal and perinatal factors in the development of childhood reading disorders. Monographs of the Society for Research in Child Development, 24.

Keogh, B. K. (1982). Research in learning disabilities: A view of status and need. In J. P. Das, R. F. Mulcahn, & A. E. Wall (Eds.), Theory and research in learning disabilities. New York: Plenum Press.

Keyser, D. J., & Sweetland, R. C. (Eds.). (1985). Test critiques (Vols. 2-8). Kansas City: Test Corporation of America.

Kitchen, W., Ford, F., Orgill, A., Rickards, A., Lissenden, J., Bajuk, B., Yu, V., Drew, J., & Campbell, N. (1987). Outcome in infants of birth weight 500 to 999 grams: A continuing regional study of 5 year survivors. Journal of Pediatrics, 111, 761-766.

Kitchen, W. H., Ryan, M. M., Rickards, A., McDougall, A. B., Billson, F. A., Kleir, E. H., & Naylor, F. D. (1980). A longitudinal study of very low birthweight infants. IV: An overview of performance at eight years of age. Developmental Medicine and Child Neurology, 22, 172-188.

Klein, N. K., Nack, M., & Breslau, N. (1989). Children who were very low birth weight: Development and academic achievement at nine years of age. Developmental and Behavioral Pediatrics, 10, 32-37.

Kopp, C. B. (1983). Risk factors in development. In M. Haith & J. Campos (Eds.), P. Mussen's manual of child development. II: Infancy and the biology of development. New York: Wiley.

Kopp, C. B., & Parmelee, A. H. (1979). Prenatal and perinatal influences on infant behavior. In J. D. Osofsky (Ed.), Handbook of infant development. New York: John Wiley & Sons.

Korones, S. B., & Lancaster, J. (1986). High risk newborn infants: The basis for intensive nursing care. St. Louis: C. V. Mosby.

Lefebvre, F., Bard, H., Veilleux, A., & Martel, C. (1988). Outcome at school age of children with birthweights of 1000 grams or less. Developmental Medicine and Child Neurology, 30, 170-180.

Lerner, J. (1981). Learning disabilities: Theories, diagnosis and teaching strategies (3rd ed.). Boston: Houghton-Mifflin.

Lindahl, E., Michelsson, K., Helenius, M., & Parre, M. (1988). Neonatal risk factors and later neurodevelopmental disturbances. Developmental Medicine and Child Neurology, 30, 571-589.

Lloyd, B. W., Wheldall, K., & Perks, D. (1988). Controlled study of intelligence and school performance of very low birthweight children from a defined geographical area. Developmental Medicine and Child Neurology, 30, 36-42.

Low, J. A., Galbraith, R. S., Muir, D., Killen, H., Pater, B., & Karchmar, J. (1982). Intrauterine growth retardation: A study of long-term morbidity. American Journal of Obstetrics and Gynecology, 142, 670-677.

Malmquist, E. (1958). Factors related to reading disabilities in the first grade of elementary school. Acta Universitatis Stockholmiensis [Stockholm Studies in Educational Psychology], 2. Stockholm: Almquist & Wiksell.

McCormick, M. C. (1985). The contribution of low birth weight in infant mortality and childhood morbidity. The New England Journal of Medicine, 312, 82-90.

McCormick, M. C. (1989). Long-term follow-up of infants discharged from neonatal intensive care units. Journal of the American Medical Association, 261, 1767-1772.

McKinney, J. D. (1987). Research on conceptually and empirically derived subtypes of specific learning disabilities. In M. C. Wang, M. C. Reynolds, & H. J. Walberg (Eds.), Handbook of special education, research and practice (Vol. 2). Oxford: Pergamon Press.

McLeskey, J., & Grizzle, K. L. (1992). Grade retention rates among students with learning disabilities. Exceptional Children, 58, 548-554.

Mercer, C. D. (1983). Students with learning disabilities. Columbus: C. E. Merrill.

Neligan, G. A., Kolvin, I., Scott, D. M., & Garside, R. F. (1976). Born too soon or born too small: A follow-up study to seven years of age. Clinics in developmental medicine (No. 61). London: Spastics International Medical Publications.

Nickel, R. E., Bennett, F. C., & Lamson, F. N. (1982). School performance of children with birth weights of 1000 g or less. American Journal of Diseases in Children, 136, 105-110.

Noble-

Pena,

Portno

Reyno

Rober

Rose,

Ross

Rubin

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Noble-Jamieson, C. M., Lukeman, D., Silverman, M., & Davies, P. (1982). Low birth weight children at school age: Neurological and pulmonary function. Seminars in Perinatology, 6, 266-273.

Pena, I. C., Teberg, A. J., & Finello, K. (1987). Effects of intrauterine growth retardation on premature infants of similar gestational age. Pediatric Research, 21, 183.

Portnoy, S., Callias, M., Wolke, D., & Gamsu, H. (1988). Five year follow up study of extremely low birthweight infants. Developmental Medicine and Child Neurology, 30, 590-598.

Reynolds, C. R. (1990). Conceptual and technical problems in learning disability diagnosis. In C. Reynolds & R. Kamphaus (Eds.), Handbook of psychological and educational assessment of children: Intelligence and achievement. New York: Guilford.

Robertson, C. M. T., Etches, P. C., & Kyle, J. M. (1990). Eight-year school performance and growth of preterm, small for gestational age infants: A comparative study with subjects matched for birth weight or for gestational age. Journal of Pediatrics, 116, 19-26.

Rose, J. S., Medway, F. J., Cantrell, V. L., & Marus, S. H. (1983). A fresh look at the retention-promotion controversy. Journal of School Psychology, 21, 201-211.

Ross, R. P. (1992). Accuracy in analysis of discrepancy scores: A nationwide study of school psychologists. School Psychology Review, 21, 480-493.

Rubin, R. A., & Balow, B. (1977). Perinatal influences on the behavior and learning problems of children. In B. B. Lahey & A. E. Kazdin (Eds.), Advances in clinical child psychology (Vol. 1). New York: Plenum Press.

Rubin, R. A., Rosenblatt, C., & Balow, B. (1973). Psychological and educational sequelae of prematurity. Pediatrics, 52, 352-363.

Rutter, M., & Yule, W. (1975). The concept of specific reading retardation. Journal of Child Psychology and Psychiatry, 16, 181-197.

Sameroff, A. J., & Chandler, M. J. (1975). Reproductive risk and the continuum of caretaking casualty. In F. D. Horowitz, M. Hetherington, S. Scarr-Salapatek, and G. Siegel (Eds.), Review of Child Development Research, 4, 187-244. Chicago: University of Chicago Press.

Sattler, J. M. (1988). Assessment of children (3rd ed.). San Diego: Author.

Satz, P., & Friel, J. (1974). Some predictive antecedents of specific reading disability: A preliminary two-year follow-up. Journal of Learning Disabilities, 7, 48-55.

Schonhaut, S., & Satz, R. (1983). Prognosis for children with l earning disabilities: A review of follow-up studies. In M. Rutter (Ed.), Developmental neuropsychiatry. New York: Guilford Press.

Sell, E. J., Gaines, J. A., Gluckman, C., & Williams, E. (1985). Early identification of learning problems in neonatal intensive care graduates. American Journal of Diseases in Children, 139, 460-463.

Shapiro, S., McCormick, M. C., Starfield, B. H., & Carwley, B. (1983). Changes in infant morbidity associated with decreases in neonatal mortality. Pediatrics, 72, 408-415.

Shepard, L. (1980). An evaluation of the regression discrepancy method for identifying children with learning disabilities. Journal of Learning Disabilities, 14, 79-91.

Shepard, L. A., & Smith, M. L. (Eds.). (1989). Flunking grades: Research and policies on retention. London: Falmer Press.

Spreen, O. (1988). Prognosis of learning disability. Journal of Consulting and Clinical Psychology, 56, 836-842.

Stewart, A. (1983). Severe perinatal hazards. In M. Rutter (Ed.), Developmental neuropsychiatry. New York: Guilford Press.

Stewart, A. L., Reynolds, E. D. R., & Lipscomb, A. P. (1981). Outcome for infants of very low birthweight: Survey of world literature. The Lancet, 1038-1041.

Taylor, R. L. (1989). Assessment of exceptional students (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Teberg, A., Walther, F. J., & Pena, I. C. (1988). Mortality, morbidity, and outcome of the small for gestational age infant. Seminars in Perinatology, 12, 84-94.

United States Office of Education. (1977). Definition and criteria for defining students as learning disabled. Federal Register, 42, 250P.65083.

United States Office of Education. (1984). Fifth annual report in Congress on the implementation of Public Law 94-142. Washington, DC: U.S. Government Printing Office.

United States Office of Education. (1992). Fourteenth annual report to Congress on the implementation of the Individuals With Disabilities Education Act. Washington, DC: U.S. Government Printing Office.

Vohr, B. R., & Hack, M. (1982). Developmental follow-up of low birth weight infants. Pediatric Clinics of North America, 29, 1441-1454.

Wallace, I. F., Escalona, S. K., McCarton-Daum, C., & Vaughan, H. G. (1982). Neonatal precursors of cognitive development in low birthweight children. Seminars in Perinatology, 6, 327-333.

Westwood, M., Kramer, M. S., Munz, D., Lovett, J. M., & Watters, G. V. (1983). Growth and development of full-term nonasphyxiated small for gestational age newborns: Follow-up through adolescence. Pediatrics, 71, 376-382.

Wiener, G. (1968). Scholastic achievement at age 12-13 of prematurely born infants. Journal of Special Education, 2, 237-250.

Wiener, G., Rider, R. V., Oppel, W. C., & Harper, P. A. (1968). Correlates of low birth weight. Psychological status at eight to ten years of age. Pediatric Research, 2, 110-118.

Wilson, L. R., & Cone, R. (1984). The regression equation method of determining academic discrepancy. Journal of School Psychology, 22, 95-110.

Ysseldyke, J. E., Algozzine, B., Richey, L., & Graden, J. (1982). Declaring students eligible for learning disabilities services: Why bother with the data? Learning Disabilities Quarterly, 5, 37-44.