DOCUMENT RESUME

ED 397 617 EC 304 949

AUTHOR Anderman, Eric M.
TITLE The Middle School Experience: Effects on the Math and Science Achievement of Learning Disabled Adolescents.
PUB DATE Mar 96
NOTE 22p.; Paper presented at the Biennial Meeting of the Society for Research on Adolescence (Boston, MA, March 7-10, 1996).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Academic Achievement; Grade 8; Junior High Schools; *Learning Disabilities; Mathematics Achievement; *Middle Schools; *School Organization; Science Education; *Student Adjustment; Transitional Programs
IDENTIFIERS Hierarchical Linear Modeling; *Middle School Students; National Education Longitudinal Study 1988

ABSTRACT

This study examined the relationship between transition from elementary to middle school and achievement gaps in math and science in eighth graders with (N=296) and without (N=1608) learning disabilities (LD). An abundance of research suggests that motivation and achievement decline during the early adolescent years, and that this decline is often attributable to the transition from elementary to middle grade schools during early adolescence. Using data from the National Education Longitudinal Study, the study found that on average there is a strong gap in achievement between LD and non-LD early adolescents. Hierarchical linear modeling was used to examine school effects on these achievement gaps. Results indicated that the gap between LD and non-LD adolescents is greatly reduced for adolescents who do not make a school transition until at least the ninth grade. Findings suggest that the policies and practices of typical middle grade schools are particularly incompatible with the educational and psychological needs of early adolescents with LD. (Contains 39 references.) (Author/DB)

Running head: MATH AND SCIENCE ACHIEVEMENT

The Middle School Experience: Effects on the Math and Science Achievement of Learning Disabled Adolescents

Eric M. Anderman

The University of Kentucky

Paper presented at the bi-annual meeting of the Society for Research in Adolescence. The research reported in this paper was supported by the US Department of Education and a faculty initiative grant from the Office of the Vice President of the University of Kentucky. Thanks for comments on earlier drafts of this article to Lynley H. Hicks and Doris Stilwell. Please address all correspondence to Eric M. Anderman, Department of Educational & Counseling Psychology, The University of Kentucky, 251 D Dickey Hall, Lexington, KY 40506-0017. E-mail: EANDE1@UKCC.UKY.EDU

Abstract

The present study examines the relationship between middle school transitions and achievement gaps in math and science between LD and non LD adolescents. An abundance of research suggests that motivation and achievement decline during the early adolescent years, and that this decline is often attributable to the transition from elementary to middle grade schools during early adolescence. Using data from the National Education Longitudinal Study (NELS), it was found that on average, there is a strong gap in achievement between LD and non LD early adolescents. Hierarchical linear modeling was used to examine school effects on these achievement gaps. Results indicate that although there are achievement gaps in math and science between LD and non LD adolescents, this gap is greatly reduced for adolescents who do not make a school transition until at least the ninth grade. It is proposed that the policies and practices of typical middle grade schools are particularly incompatible with the educational and psychological needs of early adolescents with LD.

The Middle School Experience: Effects on the Math and Science Achievement of Learning Disabled Adolescents

There has been little research involving the math and science achievement of LD students during early adolescence. This is unfortunate, since early adolescence marks a time when students make important life and career choices; a negative experience in math or science at this early age may preclude the adolescent from making future life choices that involve work in a particular domain. The present article examines the effects of school experiences during early adolescence on achievement gaps in mathematics and science between LD and non LD students.

Math and Science Achievement of LD Students

The research that has been done on the mathematics and science achievement of LD students suggests that in general, LD students do not achieve as well as their non LD peers. For example, Wigle, White, & Parish (1988) compared the reading, math, and writing achievement of both low and high IQ LD students during late childhood and early adolescence. They found that mean IQ declined over time, as did math achievement scores, while reading and writing scores remained stable. Other studies also document the gap in math achievement between LD and non LD students (e.g., Kavale & Reese, 1992), although most of these studies have not specifically examined such gaps for science achievement.

In a large scale study of LD students in the state of Iowa, Cone and his colleagues found that placement into special education services for LD students occurred more frequently due to deficiencies in reading and spelling during the early school years, while placements due to mathematical problems generally did not occur until the upper elementary years (Cone, Wilson, McDonald Bradley, & Reese, 1985). They also reported that the discrepancy between IQ and achievement for LD students increased with age. Similar findings involving age are reported in several other large scale surveys of LD students' characteristics (e.g., Ackerman, Anhalt, & Dykman, 1986; Norman & Zigmond, 1980; Sheppard & Smith, 1981).

Research has demonstrated that a number of factors may contribute to the achievement gaps between LD and non LD students. For example, Zentall and Ferkis (1993) suggest that LD students' problems with mathematics are due to a combination of problems with cognitive ability, cognitive style, and inadequate curricular materials. Montague and Applegate (1993) suggest that LD students approach mathematical problems differently than do their non-disabled peers because they lack certain cognitive strategies which are needed for effective problem solving. Shepard and Adjogah (1994) found that differences in the language processing abilities of LD and non LD students is related to differences in science achievement. These and other student-specific characteristics are important determinants of students' ability to solve mathematical and scientific problems.

School-Level Factors That Influence Achievement

A number of studies, reviews, and reports suggest that the transition from elementary to middle level schools has detrimental effects on the achievement and motivation of early adolescents (Anderman & Maehr, 1994; Carnegie, 1989; Eccles & Midgley, 1989; Eccles et al., 1993; Simmons & Blyth, 1987; Wigfield, Eccles, MacIver, Reuman, & Midgley, 1991). Nevertheless, studies to date have not examined specifically the effects of this transition on the math and science achievement of LD early adolescents.

A number of studies show that as students move from elementary to middle grade schools, achievement, motivation, and attitudes decline. In a large-scale longitudinal study of over 2,000 early adolescents, Eccles, Midgley, and their colleagues demonstrated that many of the negative changes that occur over the transition are due to contextual changes in the school environment (i.e., Eccles & Midgley, 1989; Wigfield et al., 1991). For example, while the elementary school is characterized by small classes, projects, efficacious teachers, and cooperation, the middle school environment often tends to stress rote memorization, basic skills, competition, and less creative assignments. In addition, middle school teachers often feel less efficacious than do elementary school teachers (Midgley, Anderman, & Hicks, 1995), and this contributes to changes in student performance and attitude (Midgley, Feldlaufer, & Eccles, 1989).

Simmons and her colleagues (e.g., Simmons & Blyth, 1987) demonstrated that changes in motivation and self-esteem over the transition are directly related to contextual changes in the school environment. For example, one study found that girls who moved into a traditional middle school setting displayed a decline in self-esteem, while girls who remained in a K-8 school and did not make a transition until at least the ninth grade did not experience this decline. In fact, the girls who attended the traditional middle school were still at a significant disadvantage even after entering high school.

These and other studies (e.g., Seidman, Allen, Aber, Mitchell, & Feinman, 1994) suggest that the middle school environment is antithetical to the needs of early adolescents. Eccles and Midgley refer to this as a problem of "stage-environment" fit -- adolescents are at a stage of development when they need to be in an environment where they can experience independence, growth, cooperation and creativity; however, the typical middle school provides an environment which stresses competition, grades, relative ability, and rote memorization (Eccles & Midgley, 1989). While research has demonstrated that this change in environment has detrimental effects on adolescents in general, studies to date have not examined specifically the effects of these transitions on LD students. Therefore, it is important to examine the effects of this transition on LD students, since the transition may exacerbate and contribute to achievement gaps during early adolescence.

The present study examined the relationships between school-type and achievement gaps in math and science between LD and non LD adolescents, after controlling for student-level variables which are predictive of achievement. Since prior studies have documented that student level factors such as gender, grades in school, ethnicity, perceptions of the quality of teaching, and socioeconomic status are predictive of math and science achievement (e.g. Midgley, Feldlaufer, & Eccles, 1989; Young & Fraser, 1993; 1994) these factors are controlled before examining effects of school-type on the achievement gap. Specifically, the central hypothesis of the present study is that

LD students who do not experience a school transition during early adolescence will experience less of an achievement gap than LD students who do have to make a transition, after controlling for student-level variables. The present study utilizes a relatively new statistical technique, hierarchical linear modeling (HLM), to examine the organizational effects of school context simultaneously with the effects of student characteristics on math and science achievement. HLM is a technique which allows for the simultaneous modeling of individual and grouped data. Consequently, HLM allows for more accurate analyses of students who are "nested" in schools with different characteristics than do more traditional statistical techniques.

Method

Sample

Data for the present study come from the base year of the National Education Longitudinal Study (NELS; National Center for Education Statistics, 1994). NELS is a longitudinal study sponsored by the US Department of Education Office of Educational Research and Improvement. The purpose of NELS was to examine the achievement, progress, and development of eighth graders and their schools. After the initial study was conducted in 1988, some of the students were followed-up every two years through 1994. The present study used a sub-sample from the NELS data set. The sample includes 1946 eighth grade students from 78 schools. This sample was arrived at by including students from all schools that contained at least three LD students in the NELS sample. Since many NELS schools had no LD participants, or only one or two LD participants, these schools were eliminated since it would be difficult to obtain useful differentials in achievement between the LD and non LD students.

The number of participants in the schools included in the study range from 13 to 34 students per school. Of the selected participants, 296 (15%) were classified as LD, and 1608 (85%) were not LD.[1] Since the study contains many schoc ; from different regions, different criteria were used for LD classification in various schools.

The criteria used for inclusion as an LD student in the present study are that the student is classified as LD by the school, and that the student receives some special education services during the school day. Specifically, there is one question in the NELS parent survey which asks the parents, "Is your eighth grader currently enrolled in any of the following special programs/services?" One of the specific items then asks parents to indicate if their eighth grader receives "special education services for students with learning disabilities." The 296 LD students included in the present study represent all of the students whose parents indicated that they were enrolled in special education services for students with LD during the eighth grade, and who were also in NELS schools that containe d at least three LD students in the NELS sample.

Parents also were asked to indicate if their children experienced any other exceptional conditions. According to the parents of the students included in the present study, 16 of the LD students (5.4%) and 24 of the non LD students (1.5%) had a visual handicap; 21 of the LD students (7%) and 30 of the non LD students (1.8%) had a hearing

[1] Reported frequencies do not always total 1946 due to missing data on some measures for various students.

problem; 9 of the LD students (3%) and 2 of the non LD students (0.1%) were deaf; 28 of the LD students (9.4%) and 21 of the non LD students (1.3%) had a speech problem; 5 of the LD students (1.7%) and 16 of the non LD students (1%) had an orthopedic problem; 7 of the LD students (2.3%) and 23 of the non LD students (1.4%) experienced other physical disabilities; 38 of the LD students (12.8%) and 55 of the non LD students (3.4%) had emotional problems; 9 of the LD students (3%) and 49 of the non LD students (3%)were enrolled in bilingual or bicultural education services; and 8 of the LD students (2.7%) and 12 of the non LD students (0.7%) were enrolled in English as a Second Language programs. Because the subsequent hierarchical analyses require a minimum number of students per school (see Bryk & Raudenbush, 1992), students with these various other disabilities were included in the LD and non LD samples.[2]

The full sample of LD and non LD students is evenly divided by gender (51% male, 49% female). Ninety-six percent of the students attend public schools, with the remaining 4% attending private or religious schools. Schools vary in type from K-8 (7%), K-12 (3%), 6,7, or 8-12 (12%), 3,4, or 5-8 (14%), 6-8 or 7-8 (44%), and 7-9 or 8-9 (16%). The full size of the eighth grade enrollment varies greatly, ranging from small eighth grade enrollment (18% of the sample have only 1-49 students in their class), to large enrollment (10% of the sample are in classes with over 400 students). Most students are in medium sized eighth grade classes (30% have class sizes of between 100-199 students). Twenty percent of the students attend urban schools, 44% attend suburban schools, and 36% attend rural schools. Twenty-one percent of the students belong to minority groups (primarily African American, Hispanic/Latino-American, and Native American). Since the present study includes a sub-sample of the 78 NELS schools with at least three LD students in the NELS sample, the data are not generalizable to the full sampling frame of NELS; consequently, in the present study, unweighted data are reported.

The students in the sample come from varied backgrounds. Family income for students in this sample varies, with the mean family income ranging from $20,000-$35,000. The mean family size is 4.5 individuals per household. Seventy-five percent of the eighth graders indicated currently having some college plans.

In terms of ability grouping, 23% are not ability grouped for math instruction, while 77% are grouped by ability. In science, 37% are not ability grouped while 64% are ability grouped.

Construction of Student-Level Variables

Below is a description of the development of each of the student-level variables. A plethora of variables can be used in studies predicting effects on academic achievement. The student-level variables chosen for the present study represent only the major demographic individual characteristics which prior research has identified as being important in studies of achievement of LD students (e.g., gender, socioeconomic status, minority status, grades in school, plans for the future -- see Ackerman et al., 1986; Cone

[2] One of the dependent variables in the present study represents the average difference in math and science achievement by school for LD and non LD students. Students with other disabilities were not eliminated since the slope of this differential (which is used as a dependent variable) should be more reliable given a larger sample size (see Bryk & Raudenbush, 1992, for details).

et al., 1985; Norman & Zigmond, 1980; Sheppard & Smith, 1981; Wigle et al., 1988). In this study, I also included a measure of locus of control, and a measure of students' perceptions of the quality of teaching in their schools. The justification for the inclusion of these variables in presented below. The items used to calculate all scales are presented in the appendix.

Grades. Students indicated on a 5 point scale their average grades in math, science, English, and history since the sixth grade. The measure was calculated from the mean of these four variables, in z-score format (Cronbach's Alpha = .76).

Gender, LD, College and Minority Status. Dummy variables representing gender (1 = female, 0 = male), college plans (1 = yes, 0 = no) and LD status (1 = LD, 0 = non LD) were created.. The study also includes a dummy variable for minority status, where students who are African American, Hispanic/Latino-American, or Native American are classified as minorities, while students who are Caucasian or of Asian/Pacific Island decent are classified as non minority for the present study (minority = 1, non-minority = 0).

Perceptions of Quality of Teaching. A measure of students' perceptions of the quality of teaching in their school was included, because research suggests that students' perceptions of teacher expectations, beliefs, and behaviors have a strong impact on motivation and achievement, particularly during late childhood and early adolescence (e.g., Graham, 1984; Midgley, Feldlaufer, & Eccles, 1989; Weinstein, Marshall, Sharp, & Botkin, 1987). In addition, recent school reform efforts specifically aimed at making learning environments more developmentally appropriate for early adolescents have emphasized the importance of students' perceptions of various aspects of teaching (cf., Anderman & Maehr, 1994; Maehr, Midgley, & Colleagues, in press). Students responded on a four point scale, indicating how much they agreed or disagreed with various statements about their perceptions of teaching in their school. Using principal components factor analysis, a five item composite was created from the z-score of the mean on the five items (the teaching is good, teachers are interested in students, teachers praise my effort, I feel put down by teachers, teachers really listen to what I have to say). The final scale exhibited good reliability (Cronbach's Alpha = .78).

Socioeconomic Status. This variable was constructed from parental data, and is a composite of mother and father's educational levels, occupations, and family income. The final variable is standardized (see NCES, 1988, for full details on the construction of this variable).

Locus of Control. A measure of locus of control was included, since research on students causal attributions suggests that LD (and BD) students often adopt an external locus of control, and that locus of control is an important predictor of academic achievement, particularly in LD populations (Aponik & Dembo, 1983; Foley & Epstein, 1982; Tur-Kaspa & Bryan, 1993). This factor was calculated to be as similar as possible to the locus of control measure used in the High School and Beyond Study (NCES, 1994). The final measure is a z-score, where a low score is indicative of low levels of control, and a high score indicates high perceptions of control over one's life.

Construction of School Level Variables

School Transition Variables. Two dummy coded variables were created from administrator reports of school type. One variable represents schools in which there is no transition until at least the 9th grade; most students in this classification attend K-8 or K-12 schools. The other variable represents students who experienced a transition at grades 6 , 7, or 8. The comparison group consisted of students who made a transition at grades 3, 4, or 5.

Attendance Rate. An administrator in each school supplied the average daily attendance rate for eighth grade students in the school. This rate includes excused and unexcused absences. The attendance rate was standardized using a z-score calculation.

School Safety. A composite measure of school safety was included in this study, since violence and safety in schools are important determinants of learning and achievement (cf., Berliner, 1993; Jose-Kampfner, 1994), and since levels of safety may vary by middle school type (e.g., Lindquist & Molnar, 1995; Weishew & Peng, 1993). Using items to which administrators responded, principal components factor analysis was used to identify a factor which represents how safe each school is. A high score on this factor indicates that vandalism, weapons, and theft are a major problem in this school (Cronbach's Alpha = .80, see appendix for items).

Results

I first present means and standard deviations for LD and non LD students in table 1. I also include results of a one way analysis of variance testing for differences between LD and non LD students. Table 2 contains correlations between individual (student-level) predictors.

Insert Tables 1 and 2 About Here

The LD students exhibit lower math and science achievement, and lower overall grades. The LD students also report lower levels of locus of control, and do not aspire to attend college as much as do the non LD students. The LD students in the sample come from somewhat lower SES backgrounds.

Hierarchical Linear Models

While numerous studies document achievement differences between LD and non LD students (e.g., Cone et al., 1985; Kavale & Reese, 1992), most of the studies only have included individual characteristics of students as predictors of achievement. It is plausible that these differences in achievement may vary across schools -- LD students in one school environment may outperform LD students in other schools, once individual differences have been controlled for.

In this study, I use HLM to separate the within school variation in LD students' achievement from the between school variance in achievement. By using HLM, one can model both individual student characteristics and school-level characteristics into a more comprehensive model. The model takes both student and school-level variables into account.

HLM is a relatively new statistical technique which is extremely useful for examining the effects of various organizational contexts on individual outcomes. Bryk & Raudenbush (1992) note that aggregation bias can occur when variables take on different meanings at different organizational levels. As an example, they discuss the common use of socioeconomic status (SES) as a variable in educational and psychological research. At the individual or "student" level, SES may serve as a measure of the resources available in a student's home; but, at the "school" level, the average SES may represent the resources available in the school. It is statistically inappropriate to assign the average level of SES for all students in a given school as a student-level variable -- indeed, this is not a characteristic of the individual student, but a characteristic of the school that the student attends. By using HLM in such situations, researchers can break down the relationships between SES and a dependent variable (e.g., achievement) into separate Level-1 or "student" and Level-2 or "school" models (see Bryk & Raudenbush, 1992, pp. 84-85).

Consequently, in the present study, the use of HLM allows for the simultaneous examination of student and school-level factors that may be related to the lower achievement of LD students in math and science. Just as SES may vary between schools (i.e., some schools have a higher average SES than do other schools for a variety of reasons), the difference in achievement between LD and non LD students also may vary between schools. Research clearly suggests that LD students do not perform as well in math and science as non LD students (Ackerman et al., 1986; Cone et al., 1985; Norman & Zigmond, 1980; Sheppard & Smith, 1981; Wigle et al., 1988). However, no studies to date have used multilevel analyses to separate student and school characteristics in order to help to explain the types of environments which may account for these differences.

From a more technical perspective, multilevel regression techniques such as HLM calculate standard errors of the estimates more appropriately than do more common ordinary least squares (OLS) approaches (Patterson, 1991). When researchers use OLS techniques with nested data, the standard errors often are calculated as too small. Therefore, confidence intervals are also calculated as being too small.

How Much Does Achievement Vary Between Schools?

First, an unconditional HLM model was calculated, examining the amount of variance in math and science achievement that lies between schools for both LD and non LD students. Since one of the major purposes of the present study is to examine school-level effects on math and science achievement of LD students, it is important to examine the amount of variance in these variables that lies between schools for all students before controlling for individual and school-level variables which may help to explain the lower achievement of LD students (cf., Bryk & Raudenbush, 1992). The variance that lies between schools (intraclass correlation) is 0.18 for mathematics, and 0.13 for science.[3] This means that in mathematics, 18% of the variance in math achievement lies between schools, and this variance may be explained by school-level variables.

[3] Adjusted for reliability of measures.

The Student Level Model

I first formed a student level HLM model, which uses student-level data as predictors of math and science achievement. The within-school, or "student" model is represented by the following equation:

$$\text{Achievement} = \beta_{0j} + \beta_{1j}\,(\text{LD/Non LD Differential}) + \beta_{2j}\,(\text{Quality of Teaching}) + \beta_{3j}\,(\text{Locus of Control}) + \beta_{4j}\,(\text{College Plans}) + \beta_{5j}\,(\text{Gender}) + \beta_{6j}\,(\text{SES}) + \beta_{7j}\,(\text{Grades}) + \beta_{8j}\,(\text{Minority Status}) + \varepsilon_{ij}$$ [4]

where

β_{0j} = Mean math/science achievement for students in school j.
β_{1j} = Relationship of achievement to LD/non LD differential in school j.
β_{2j} = Relationship of achievement to quality of teaching in school j.
β_{3j} = Relationship of achievement to locus of control in school j.
β_{4j} = Relationship of achievement to college plans in school j.
β_{5j} = Relationship of achievement to student's gender in school j
β_{6j} = Relationship of achievement to SES in school j.
β_{7j} = Relationship of achievement to grades in school j.
β_{8j} = Relationship of achievement to minority status in school j.

The dependent variables in these analyses are the students' scores on the math and science achievement tests. The LD/non LD differential is a predictor variable which is a dummy variable representing whether or not the student is classified as LD (value = 1) or non LD (value = 0). In the student-level model (prior to adding school-level predictors to the model), this variable should be interpreted as a standard dummy variable as used in a traditional multiple regression analysis. Thus the calculated values for this variable in the equation will represent the effect of being classified as LD or non LD on math or science achievement, after controlling for other variables.

The Full Model

The student-level model is similar to a more typical OLS regression model. However, the advantage of using HLM is that one also may add in school-level predictors and examine the ways in which these predictors influence the intercept and the slopes of various predictors. For math and science, the effects of several school-level variables on mean differences in achievement (β_{0j}) and on the LD/non LD differential (β_{1j}) were modeled. This means that school-level variables are used to explain differences in math and science achievement (after controlling for characteristics of individual students) for all students, and for achievement differences between LD and non LD students. For math, I also modeled the effects of school level variables on the slope for quality of teaching (β_{2j}) (I did not model this slope for science since it was unrelated to science achievement, and

[4] Quality of teaching and parental involvement were omitted from the science achievement model since they were not significant predictors. Although there were no significant differences for LD/non LD students reported in Table 1, they were kept in the math HLM model since they were significant when school level variables were entered into the model.

thus eliminated from the model). Thus these parameters are allowed to vary between schools, while the other student-level variables are fixed -- in this way, they are controlled for at the student level, but not modeled as effects between schools (see Bryk & Raudenbush, 1992, for a full explanation).

The between-school model examining between-school differences in math and science achievement can be expressed by the equation:

$$\beta_{0j} = \theta_{00} + \theta_{01} \text{ (Attendance Rate)} + \theta_{02} \text{ (School Safety)} + u_{0j},$$

where θ_{00} = the intercept term for achievement, controlling for other school-level variables, θ_{01} = the effect of school attendance rate within a given school on students' achievement, and θ_{02} = the effect of the school's level of safety in a given school on students' achievement in math or science. In this model, the dependent variable is the average math or science achievement in each school. The independent variables are the school-level variables that are related to average achievement within a given school.

The between-school equation examining variation in the LD/non LD differential slope is expressed by the following equation:

$$\beta_{1j} = \theta_{10} + \theta_{11} \text{ (School Safety)} + \theta_{12} \text{ (Transition Grade 6/7)} + \theta_{13} \text{ (No Transition Until at Least 9th Grade)} + u_{1j},$$

where θ_{10} = the intercept term for the LD/non LD slope, adjusted for other school variables, θ_{11} = the effect of school safety within a given school on the relationship between the LD/non LD differential slope and achievement, θ_{12} = the effect of having a school transition in grades six or seven within a given school on the relation between the LD/non LD slope and achievement, and θ_{13} = the effect of experiencing no transition until at least the ninth grade on the relation between the LD/non LD slope and achievement.[5]

In this equation, the dependent variable represents the relationship between the LD/non LD differential and achievement in a given school. Recall that the major research question in the present study concerns the effect of school environment during early adolescence on the math and science achievement of LD students. Thus this dependent variable is an extremely important variable in the present study. Specifically, this equation or model represents the effects of school characteristics (e.g., time of school transition, school safety, etc.) on the relationship between the LD/non LD achievement gap and overall achievement in a given school. Thus significant values for predictor variables in this model are indicative of school-level factors which are related to differences in achievement between LD and non LD students in a given school.

Results of the full HLM model, including student and school-level variables, are presented in Table 3.

Insert Table 3 About Here

[5] The effects of school safety and type of transition also are modeled on the quality of teaching slope, for math achievement only.

All variables have been standardized using z-scores, with a mean of 0 and a standard deviation of 1.0; therefore, all reported coefficients are represented in terms of effect sizes.

All of the fixed effects were significant predictors of math and science achievement. Higher achieving eighth grade students report higher levels of locus of control, are more likely attend college in the future, are male, are of high SES backgrounds, had higher levels of prior achievement, and tend not to be members of minority groups.

The advantage of using HLM, as opposed to OLS techniques, is that one also can model school-level variables on the intercept (mean achievement) and the LD/non LD slope differential. The gamma coefficients should be interpreted as additive effects, just as they would be interpreted in a more traditional multiple regression model. The top section of Table 3 reveals that math and science achievement is higher in schools with higher attendance rates, and is lower in schools where student safety is a problem.

Recall that in the present study, rather than examining the difference between LD students' expected and actual achievement, the HLM model allows us to compare the differences within each school between the actual performance of LD students and non LD students. This is an important distinction. The use of HLM specifically allows us to examine the relationships between school-level variables and the differences in math and science performance between LD and non LD students. Thus the results may suggest school-level variables which are predictive of why LD students do not do as well in math and science as non LD students.

The results reveal that on average, LD students score 0.70 SD lower in math and 0.58 SD lower in science than non LD students <u>across schools</u>. However, in math, when the students do not experience a transition until at least the ninth grade, the difference in achievement between LD and non LD students is virtually zero (since the value of .69 SD for no transition until at least grade nine and the value of -.70 SD for the average LD achievement difference virtually cancel each other out, since they add to -.01 SD); for science, the LD students still do not do as well as the non LD students, but the differential on average is lower (.58 SD - .46 SD = .12 SD) Therefore, after controlling for other variables, the difference in science achievement between LD and non LD students is lowered from .58 SD to only .12 SD for students who do not make a transition until at least the ninth grade. In addition, when students do experience a transition in grades six or seven, students' perceptions of higher quality teaching are related to greater achievement in math.

<u>Explained Variance</u>

The present HLM models do not include an exhaustive set of variables which might account for between school variance in achievement. Rather, the purpose of the present study is to examine the hypothesis that achievement differentials between LD and non LD students vary by school type. Nevertheless, it is possible to calculate the percentage of variance explained in the various random parameters in an HLM model. By comparing variances from the unconditional HLM models (with no predictors) to the final models, I determined that the full models explained 40% of the variance that occurred between schools in math, and 30% of the variance that occurred between schools in science. By comparing variances for the LD/non LD slope, I determined that the full model for math explained 43% of the variance in the LD/non LD achievement gap between schools, and the model for science explained 50% of the variance in the science achievement gap.[6]

Discussion

While research clearly has identified the transition from elementary to middle level schools as a tumultuous and difficult period in the lives of early adolescents (cf., Eccles & Midgley, 1989), studies have failed to examine the relationships between school-type and academic achievement for LD students during adolescence. The results of the present study demonstrate that achievement differences in math and science between LD and non LD eighth grade adolescents are much smaller in schools where students do not experience a transition until at least the ninth grade.

Why Do LD Students Do Better in Non-Transition Schools?

There are a number of reasons why LD students may do better in school when they do not experience a transition during early adolescence. Research conducted during the past decade clearly indicates that a school transition is often a troublesome time for adolescents, often having enduring negative effects on achievement, motivation, and aspirations (Anderman & Maehr, 1994; Eccles & Midgley, 1989; Simmons & Blyth, 1987). The range of psychological, social, and academic problems that LD students have to contend with during this stage of development may make them even more vulnerable to the effects of such transitions (e.g., Deci & Chandler, 1986; Swanson, 1987). Consequently, when the early adolescent has to manage both a difficult school transition and a learning disability, the student may suffer more extensive achievement decrements.

In contrast, when students attend schools which do not have a transition until at least the ninth grade, LD students do not have to contend with the added pressure of this transition. As other researchers have found (e.g., Simmons & Blyth, 1987), the absence of a school transition may be tied to higher levels of motivation and achievement. Results of the present study corroborate this finding for math and science achievement.

It is important to note that there is nothing magical about the time when the middle school transition occurs; rather, research has shown that schools with grades 5-7, 6-8, or 7-9 structures often engage in practices which are highly antithetical to the psychological needs of early adolescents (Eccles & Midgley, 1989). For example, these schools tend to have highly structured environments, to use a lot of between-class ability grouping, and to offer students few opportunities to do creative, challenging, and meaningful academic tasks (Anderman & Maehr, 1994; Eccles & Midgley, 1989). Adolescents experience these changes in school environments at a developmentally crucial period -- a time when

---

[6] The proportion of variance explained in the dependent variables was determined by subtracting the variance component from the full model from the variance of the fully unconditional model, and then dividing by the variance of the unconditional model; for the LD/non LD slope, the proportion of explained variance was determined by subtracting the variance of the slope from the full model from the variance of the slope from a level one model containing just the slope as a predictor, and then dividing by the latter value (see Bryk & Raudenbush, 1992, pp. 70-74 for full details on these procedures).

adolescents need to experience autonomy, independence, creativity, and a sense of belonging (Eccles et al., 1993). The transition from the elementary school environment to the more impersonal middle school is difficult for all adolescents; however, results of the present study suggest that it may be a particularly difficult period for students who also experience learning disabilities.

Future studies should identify the specific school practices which lead to higher levels of achievement for LD students in school districts where there is no school transition. In addition, researchers need to identify larger samples of LD students within schools than was possiole in the present study.

Judging the Effects

The reported effect sizes for the LD/non LD differential in achievement are strong. By using the effect size metric, it is possible to compare the effect sizes in one study to those in another. When one examines various meta-analyses, it is evident that effect sizes of 0.69 for math and 0.46 for science (for LD students in schools with no transition until at least the ninth grade) found in the present study are quite strong. For example, Weinstein and his colleagues (Weinstein, Boulanger, & Walberg, 1982) reviewed innovative science curricula and described an overall effect size of 0.31 as a "moderate" effect. Shymansky and his colleagues (Shymansky, Kyle, & Alport, 1983) also reviewed science curricula and described an effect size of 0.43 as a "valued" effect. In comparisons of modern and traditional math curricula, Athappilly and colleagues (Athappilly, Smidchens, & Kofel, 1983) interpret an overall effect size of 0.24 as "beneficial."

The Use of HLM

The use of multilevel techniques such as HLM has been absent from the LD literature. Although other studies have documented the lower achievement of LD students, studies to date have not controlled for student level characteristics such as gender, grades, and SES, while simultaneously examining the effects of contextual variables on LD students' achievement.

There are of course certain limitations to HLM. For example, it is difficult to use HLM with small samples of students. In addition, results of the present study do not indicate the specific mechanisms involved in producing this achievement differential. Indeed, the purpose of the present study was not to specifically identify practices that may lead to higher achievement. Nevertheless, results of the present study do indicate that the "problem" of LD students not performing as well in math and science during adolescence may not be universal -- different school experiences during early adolescence may lead to better achievement for some LD students.

References

Ackerman, P.T., Anhalt, J.M., & Dykman, R.A. (1986). Arithmetic automatization failure in children with attention and reading disorders: Associations and sequel. Journal of Learning Disabilities, 19, 222-232.

Anderman, E.M., & Maehr, M.L. (1994). Motivation and schooling in the middle grades. Review of Educational Research, 64(2), 287-309.

Aponik, D.A., & Dembo, M.H. (1983). LD and normal adolescents' causal attributions of success and failure at different levels of task difficulty. Learning Disability Quarterly, 6(1), 31-39.

Athappilly, K., Smidchens, U., & Kofel, J.W. (1983). A computer-based meta-analysis of the effect of modern mathematics in comparison with traditional mathematics. Educational Evaluation and Policy Analysis, 5, 485-493.

Berliner, D.C. (1993). International comparisons of student achievement: A false guide for reform. National Forum: Phi Kappa Phi Journal, 73(4), 25-29.

Bryk, A.S., & Raudenbush, S.W. (1992). Hierarchical linear models. Newbury Park, CA: Sage.

Carnegie Council on Adolescent Development (1989). Turning points: Preparing American youth for the 21st century (Report of the Task Force on Education of Young Adolescents). New York: Author.

Cone, T.E., Wilson, L.R., McDonald Bradley, C., & Reese, J.H. (1985). Characteristics of LD students in Iowa: An empirical investigation. Learning Disabilities Quarterly, 8, 211-220.

Deci, E.L., & Chandler, C.L. (1986). The importance of motivation for the future of the LD field. Journal of Learning Disabilities, 19(10), 587-594.

Eccles, J.S., & Midgley, C. (1989). Stage/environment fit: Developmentally appropriate classrooms for early adolescents. In R.E. Ames & C. Ames (Eds.), Research on motivation in education (Vol. 3, pp. 139-186). New York: Academic.

Eccles, J.S., Midgley, C., Wigfield, A., Miller-Buchannan, C., Reuman, D., Flanagan, C., & MacIver, D. (1993). Development during adolescence: The impact of stage-environment fit on young adolescents; experiences in schools and families. American Psychologist, 48, 90-101.

Foley, R.M., & Epstein, M. (1992). Correlates of the academic achievement of adolescents with behavioral disorders. Behavioral Disorders, 18(1), 9-17.

Graham, S. (1984). Communicating sympathy and anger to black and white children: The cognitive (attributional) consequences of affective cues. Journal of Personality and Social Psychology, 47, 14-28.

Jose-Kampfner, C. (1994, April). Youth helping youth: Linking violence to poor school performance in the Latino community. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Kavale, K.A., & Reese, J.H. (1992). The character of learning disabilities: An Iowa profile. Learning Disabilities Quarterly, 15(2), 74-94.

Lindquist, B., & Molnar, A. (1995). Children learn what they live. Educational Leadership, 52(5), 50-51.

Maehr, M.L., Midgley, C., & Colleagues (in press). Transforming school cultures. Boulder, CO: Westview Press.

Midgley, C., Anderman, E.M., & Hicks, L. (1995). Differences between elementary and middle school teachers and students: A goal theory approach. Journal of Early Adolescence, 15(1), 90-113.

Midgley, C., Feldlaufer, H., & Eccles, J.S. (1989). Student/teacher relations and attitudes toward mathematics before and after the transition to junior high school. Child Development, 60, 981-992.

Montague, M., & Applegate, B. (1993). Middle school students' mathematical problem solving: An analysis of think-aloud protocols. Learning Disability Quarterly, 16(1), 19-33.

National Center for Education Statistics (1988). NELS 88: First follow up: Student component data file user's manual. Washington, DC: US Department of Education.

National Center for Education Statistics (1994). National educational longitudinal survey. Washington, DC: US Department of Education.

Norman, D.A., & Zigmond, N. (1980). Characteristics of children labeled and served as learning disabled in school systems affiliated with child service demonstration centers. Journal of Learning Disabilities, 9, 542-547.

Patterson, L. (1991). An introduction to multilevel modeling. In S.W. Raudenbush & J.D. Wilms (Eds.). Schools, classrooms, and pupils: International studies of schooling from a multilevel perspective. San Diego, CA: Academic Press.

Seidman, E., Allen, L., Aber, J.L., Mitchell, C., & Feinman, J. (1994). The impact of school transitions in early adolescence on the self-system and perceived social context of poor urban youth. Child Development, 65, 507-522.

Shepard, T., & Adjogah, S. (1994). Science performance of students with learning disabilities on language-based measures. Learning Disabilities Research and Practice, 9(4), 219-225.

Sheppard, L., & Smith, M.L. (1981, February). Evaluation of the identification of perceptual communicative disorders in Colorado: Final Report. Boulder, CO: University of Colorado, Laboratory of Educational Research.

Shymansky, J.A., Kyle, W.C., & Alport, J.M. (1983). The effects of new science curricula on student performance. Journal of Research in Science Teaching, 20, 387-404.

Simmons, R.G., & Blyth, D.A. (1987). Moving into adolescence. Hawthorne, NY: de Gruyter.

Swanson, H.L. (Ed.). (1987). Memory and learning disabilities: Advances in learning and behavioral disabilities. Greenwich, CT: JAI Press.

Tur-Kaspa, H., & Bryan, T. (1993). Social attributions of students with learning disabilities. Exceptionality: A Research Journal, 4(4), 229-243.

Weinstein, R., Marshall, H., Sharp, L., & Botkin, M. (1987). Pygmalion and the student: Age and classroom differences in children's awareness of teacher expectations. Child Development, 58, 1079-1093.

Weinstein, T., Boulanger, F.D., & Walberg, H.J. (1982). Science curriculum effects in high school: A quantitative synthesis. Journal of Research in Science Teaching, 19, 511-522.

Weishew, N.L., & Peng, S.S. (1993). Variables predicting students' problem behaviors. Journal of Educational Research, 87(1), 5-17.

Wigfield, A., Eccles, J.S., MacIver, D., Reuman, D.A., & Midgley, C. (1991). Transitions during early adolescence: Changes in children's self-esteem across the transition to junior high school. Developmental Psychology, 27, 552-565.

Wigle, S., White, W.J., & Parish, T.S. (1988). A longitudinal comparison of high IQ and low IQ LD students. Reading Improvement, 25(4), 282-285.

Young, D., & Fraser, B.J. (1994). Gender differences in science achievement: Do school effects make a difference. Journal of Research in Science Teaching, 31, 857-871.

Young, D., & Fraser, B.J. (1993, April). Socioeconomic effects on science achievement: An Australian perspective. Paper presented at the annual meeting of the American Educational Research Association, Atlanta, GA.

Zentall, S.S., & Ferkis, M.A. (1993). Mathematical problem solving for children with ADHD, with and without learning disabilities. Learning Disability Quarterly, 16(1), 6-18.

Table 2

Zero Order Correlations Between Student Level Predictors

Variable	1	2	3	4	5	6	7	8
1. Locus of Control	1.00							
2. LD	-.18**	1.00						
3. College Plans	.23**	-.18 *	1.00					
4. Gender	.05*	-.10**	.09**	1.00				
5. SES	.19**	-.11**	.33**	.01	1.00			
6. Grades	.31**	-.24**	.38**	.12**	.31**	1.00		
7. Minority	-.08**	.02	-.03	-.03	-.21**	-.13**	1.00	
8.Teaching Climate	-.23**	.01	-.09**	-.05	-.08**	-.24**	-.01	1.00

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

Note. All coefficients presented are standardized (effect sizes).
For LD, 1 = LD, 0 = non LD; for gender, 1 = female, 0 = male; for minority status, 1 = minority, 0 = non minority; for plans to attend college, 1 = does plan to attend, 0 = does not plan to attend;all school-level transition variables are coded 1 = student had this transition, 0 = did not have this transition.

Table 1
Means and Standard Deviations For Student Level Variables

Variable	LD	Non LD	F
Math Achievement	-0.76 (0.62)	0.15 (0.99)	230.44***
Science Achievement	-0.68 (0.76)	0.13 (0.99)	181.00***
Grades	-0.56 (0.92)	0.11 (0.98)	112.03***
Locus of Control	-0.34 (0.84)	0.04 (0.71)	63.99***
Perceptions of Good Teaching	0.01 (1.06)	-0.00 (1.00)	0.05
College Plans	0.58 (0.50)	0.78 (0.41)	58.17***
Socioeconomic Status	-0.33 (0.78)	-0.11 (0.72)	24.85***

*** $p<.001$

Note. All coefficients presented are standardized (effect sizes). For college plans, 1 = does plan to attend college, 0 = does not plan to attend college.

Table 3
Full HLM LD/Non-LD Differential Model

Random Effects	Gamma Coefficient For Math	Gamma Coefficients For Science
Mean Achievement	0.09	0.08
School Attendance Rate	0.11***	0.06ᵗ
School is Unsafe	-0.09**	-0.07*
Average LD Achievement Difference	-0.70***	-0.58***
School Is Unsafe	0.14**	--------
Transition in Grades 6 or 7	0.14	0.06
No Transition Until at Least Grade 9	0.69***	0.46*
Average Perceptions of Quality of Teaching	-0.05	--------
School is Unsafe	0.00	--------
Transition Grades 6 or 7	0.13**	--------
No Transition	0.10	--------
Fixed Effects		
Locus of Control	0.11***	0.15***
Plans to Attend College	0.10*	0.11**
Gender	-0.18***	-0.19***
Socioeconomic Status	0.21***	0.23***
Grades	0.38***	0.30***
Minority Status	-0.16***	-0.14**

ᵗ*p*<.10 **p*<.05 ***p*<.01 ****p*<.001

Note. All coefficients presented are standardized (effect sizes).
For LD, 1 = LD, 0 = non LD; for gender, 1 = female, 0 = male; for minority status, 1 = minority, 0 = non minority; for plans to attend college, 1 = does plan to attend, 0 = does not plan to attend; all school-level transition variables are coded 1 = student had this transition, 0 = did not have this transition.

Appendix
Items Used to Compute Scales

Measure	Items	Response Scale
Locus of Control	I don't have enough control over the direction my life is taking. In my life, good luck is more important than hard work for success. Every time I try to get ahead, something or somebody stops me. My plans hardly ever work out, so planning only makes me unhappy. When I make plans, I am almost certain I can make them work. Chance and luck are very important for what happens in my life.	1 = strongly agree 2 = agree 3 = disagree 4 = strongly disagree
Quality of Teaching	Teachers are interested in students. Most of my teachers listen to what I say. The teaching is good. Teachers praise my effort. In class, I feel put down by my teachers.	1 = strongly agree 2 = agree 3 = disagree 4 = strongly disagree
Grades	*For each of the school subjects listed below, mark the statement that best describes your grades from sixth grade up till now:* English Math Science Social Studies	1 = Mostly A's 2 = Mostly B's 3 = Mostly C's 4 = Mostly D's 5 = Mostly below D 6 = Not graded
School Safety	Indicate the degree to which each of the following is a problem in your school: physical conflicts among students robbery or theft vandalism of school property student possession of weapons	1 = serious 2 = moderate 3 = minor 4 = not a problem
Socioeconomic Status	This variable is a standardized (z-score) variable pre-computed by NELS personnel. The variable is composed of measures of mother's occupation, father's occupation, mother's education, father's education, and family income.	

Note. All scales were computed from student NELS data, except the School Safety scale, which was developed using administrators' responses to the school-level administrator survey. Therefore, responses to the school safety scale represent the responses for one administrator from each school. In computing the "grades" scale, classes that were not graded were treated as missing data.