4. What Factors Are Associated With the Academic Achievement of Youth With Disabilities?

Analyses of the original NLTS (Wagner, Blackorby, and Hebbeler 1993), earlier analyses of NLTS2 (Blackorby et al. 2003), and analyses of the Special Education Elementary Longitudinal Study (SEELS) (Blackorby et al. 2004) suggest that the academic achievement of students with disabilities is the result of a complex interplay of many factors. These studies show that some factors are intrinsic to youth themselves (e.g., disability and functioning); some are characteristics of their family environment (e.g., family support for education); and some involve experiences in and outside of school (e.g., having been retained at grade level). We know that many of the factors are interrelated, which complicates the task of understanding how they are associated with the academic achievement of youth with disabilities. For example, many disabilities are defined by specific functional limitations, such as auditory and sight limitations among those with visual or hearing impairments, social skills limitations among youth with emotional disturbances or autism, physical limitations among those with orthopedic impairments, and cognitive challenges among those with mental retardation (Wagner et al. 2003). Yet youth within these disability categories differ in the extent of limitation, with the severity of limitation potentially helping to explain variation in academic achievement beyond the disability category label alone. Interrelationships also are apparent regarding demographic factors; for example, African American and Hispanic youth with disabilities are more likely than White youth to be living in households with incomes below the federal poverty threshold, as are youth with mental retardation relative to youth in most other disability categories (Marder et al. 2003).

Multivariate statistical analyses (i.e., linear regression when dependent measures are continuous, as in the case of standard scores on academic assessments) are required to disentangle these kinds of interrelationships and identify how various factors relate to academic achievement, independent of other factors. Such analyses estimate the magnitude and direction of relationships for numerous explanatory factors, statistically holding constant the other factors included simultaneously in the analyses.[1] The multivariate analysis results reported in this chapter attempt to explain variation in the standard scores of youth with disabilities on three subtests related to reading (passage comprehension), mathematics (calculations), and content knowledge (in science).[2] The factors included as independent variables in these multivariate analyses are drawn from the NLTS2 conceptual framework and are described in the following section, followed by a presentation of the analysis results.

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[1] Multivariate analyses identify relationships between a variety of factors and student outcomes, but findings do not imply that the factors cause the outcomes. For example, higher absenteeism is negatively associated with some measures of academic performance, independent of other differences between youth. However, this does not imply that absenteeism causes poorer academic performance; it could be that poor-performing students are less engaged in their schooling and, therefore, absent more often.

[2] One measure was chosen from each of the three academic domains (language arts, mathematics, and content knowledge), for parsimony in presenting the results. Multivariate analysis results for the other three subtests (synonyms/antonyms, applied problem solving, and social studies content knowledge) are quite similar to those presented here and are included in appendix C. Footnotes in this chapter summarize those relationships.

Hypothesized Relationships to the Academic Achievement of Youth With Disabilities

Previous research on students with disabilities (Blackorby et al. 2003; Blackorby et al. 2004; Wagner, Blackorby, and Hebbeler 1993) and other research, noted below, suggest three broad categories of factors that may help explain variations in the academic achievement of youth with disabilities:

- individual characteristics of youth;
- characteristics of their households; and
- school experiences.[3]

Factors within each of these categories that are included in NLTS2 analyses are described below. In addition, the accommodations provided youth with disabilities as part of their individualized education programs (IEPs) that also were provided during the direct assessment may relate to the assessment scores.

Individual Characteristics of Youth

As noted above, the academic achievement of youth with disabilities results from dynamic processes in which youth are active participants. For example, the learning that promotes academic achievement occurs as teachers and students interact with each other and with instructional content and activities. What youth bring to these processes may be related to their success. Three major types of individual characteristics are hypothesized to relate to the academic performance of youth: disability characteristics, functioning, and demographics.

Disability Characteristics

In considering variations in the academic performance of youth, it is important to understand the relationships between performance and of the following aspects of their disabilities.

- **Disability category.** The nature of a particular youth's disability can powerfully condition his or her experiences, as demonstrated in all reports of NLTS2 findings. Dichotomous variables are included in analyses that distinguish youth according to the federally defined special education disability categories in use for secondary-school-age students (see appendix A, table A-10, for definitions of these categories).[4]

  The assignment of youth to a disability category is based on the primary disability designated by the youth's school or district in the 2000-01 school year. Although there are federal definitions for each disability category, criteria and methods for determining eligibility under particular categories vary widely from state to state. Therefore, NLTS2 category designations should be interpreted as describing those reported to have a particular disability, rather than those who have that disability.

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[3] Multivariate analyses do not include factors related to youth's complete school programs because data available from the Students' School Program Survey regarding course-taking and other key aspects of those programs are for only a single school year. Students' transcripts, which will depict their complete high school career up to the point of their assessment, are expected to yield data that will be more strongly related to overall academic achievement. Transcripts are being collected as youth complete high school and, thus, are not yet available.

[4] For analysis purposes, the deaf-blind category was combined with the multiple disability category because it is too small to be analyzed separately.

Overall, 62 percent of youth receiving special education in the NLTS2 age range are classified as having a learning disability (Marder, Levine, and Wagner 2003). Youth with mental retardation and emotional disturbances make up 12 percent and 11 percent of students, respectively. Another 5 percent of youth are classified as having other health impairments, and 4 percent are identified as having speech/language impairments. The seven remaining disability categories each account for 1 percent or fewer of students and, together, make up about 5 percent of youth with disabilities. The nature of a youth's disability is hypothesized to account for much of the variation in academic achievement, with youth in such categories as visual, hearing, or speech impairment generally experiencing more positive outcomes than, for example, youth in categories such as multiple disabilities or mental retardation (Blackorby et al. 2003).

- **Age at identification of disability.** Early identification of a disability can indicate that the disability affects functioning in obvious, recognizable ways at a young age, compared with disabilities that are recognized in later childhood or adolescence. Thus, on average, youth whose disabilities were identified at an earlier age could have greater challenges to academic performance. Parents reported the age at which youth first exhibited a physical, learning, or other disability or problem for which they eventually were diagnosed. Although the average age is 5.7 years, approximately one in five youth have disabilities that first were diagnosed when they were infants or toddlers, and another 11 percent have disabilities or delays that were identified in their preschool years. School entry, at age 5 or 6, was when almost one-third of youth first had their disabilities identified, whereas 19 percent did not have their disabilities identified until they were at least 9 years old. Age at identification is confounded with type of disability in that sensory and orthopedic impairments tend to be recognized earlier than learning disabilities, for example, which generally are identified when children reach school age (Wagner, Marder, and Cardoso 2003).

Functioning

NLTS2 findings demonstrate the considerable variation in skills across several dimensions among youth who share a primary disability category designation (Cameto et al. 2003; Wagner et al. 2003). To assess the relationship between functioning and academic performance, NLTS2 analyses include variables that distinguish the level of functioning of youth with disabilities in the areas noted below.

- **Number of domains influenced by disability.** The number of functional domains affected by disability indicates the breadth of the potential impact of disability on the outcomes youth may achieve. To assess the breadth of the functional impacts of youth's disabilities, parents were asked to report whether youth experience limitations in seven areas: general health; vision; hearing; use of arms, hands, legs, and feet; expressive language; receptive language; and participation in bidirectional communication. Parents of youth with disabilities report that about half have problems in at least one area, whereas about 1 in 10 have problems in four or more of these areas (Wagner et al. 2003). Having a disability that impacts fewer areas is expected to relate to higher academic performance (Blackorby et al. 2003).

- **Functional cognitive skills.** Parents were asked to use a 4-point scale ranging from "not at all well" to "very well" to evaluate four of their sons' or daughters' skills that often are used in daily activities: reading and understanding common signs, telling time on a clock with hands, counting change, and looking up telephone numbers and using the telephone. These skills are referred to as "functional cognitive skills" because they require the cognitive ability to read, count, and calculate. As such, they suggest much about students' abilities to perform a variety of more complex cognitive tasks. However, they also require sensory and motor skills—for example, to see signs, manipulate a telephone, and so on. Consequently, a high score indicates high functioning in all of these areas, but a low score can result from a deficit in the cognitive, sensory, and/or motor domains. A summative scale of parents' ratings of these functional cognitive skills ranges from 4 (all skills done "not at all well") to 16 (all skills done "very well"). Approximately half of youth with disabilities score in the high range on this scale (15 or 16); almost 6 percent score in the low range (4 to 8). As an indicator of the ability to process information that is important to daily functioning, higher functional cognitive skills are expected to relate strongly to academic achievement (Blackorby et al. 2003; Blackorby et al. 2004).
- **Social skills.** Poor academic performance has been shown to be an "indirect consequence" of poor social skills at school (National Association of School Psychologists 2002); hence, higher social skills are expected to relate to higher academic performance, as measured by standardized assessments. The social skills of youth with disabilities were assessed by asking parents to respond to nine items drawn from the Social Skills Rating System (SSRS), Parent Form (Gresham and Elliott 1990). Items were selected from the assertion and self-control subscales, skill sets considered by the design team to be most relevant to school success. Individual items were selected because they had high factor loadings on the relevant subscale and/or did not duplicate particular skills (e.g., controls temper with children and controls temper with the parent were not both selected).

  Parents were asked whether their adolescent children exhibit each of the following characteristics "never," "sometimes," or "always" (scoring 0, 1, or 2, respectively):

  - makes friends easily;
  - seems confident in social situations, such as parties or group outings;
  - joins group activities without being told to, such as a group having lunch together;
  - starts conversations rather than waiting for others to start;
  - ends disagreements with [parent] calmly;
  - controls temper when arguing with peers other than siblings;
  - speaks in an appropriate tone of voice at home;
  - receives criticism well; and
  - gets into situations that are likely to result in trouble (reverse coded).[5]

[5] The original SSRS item, worded "avoids situations that are likely to result in trouble," was altered in the initial days of interviewing parents because a significant number of them had difficulty understanding the item when not seeing it written in front of them, as is the usual mode of administration for the SSRS.

The first four items come from the assertion subscale, and the last five come from the self-control subscale. Intercorrelations of the assertion subscale items range from .35 ($p < .001$) to .55 ($p < .001$). Intercorrelations of the self-control subscale items range from .13 ($p < .001$) to .33 ($p < .001$).

An overall measure of social skills was created by summing the values across the nine items, producing a scale with raw scores that range from 0 to 18 and have a mean and standard deviation of 11.4 and 3.15.

To standardize the scale for the NLTS2 sample, a standardization sample was requested from American Guidance Services, Inc. (AGS), which distributes the SSRS. AGS graciously provided NLTS2 with the entire 174-case sample that the developers used to standardize the parent form of the SSRS for secondary-level students (7th to 12th graders in spring of 1988). The nine items (with values of 0, 1, and 2) were summed, and the mean and standard deviation were calculated. The mean of the 9-item scale for the 174-case SSRS standardization sample is 12.3, and the standard deviation is 2.79 (the range is 6 to 18). This mean and standard deviation were used to create standardized scores for youth with disabilities as follows:

$$z_i = \frac{x_i - \mu}{\sigma}$$

Where:

- z_i = the z-score of the nine-item social skills scale for student *i* in the NLTS2 sample
- x_i = the sum of the nine items comprising the NLTS2 social skills scale for student *i* in the NLTS2 sample
- μ = the mean of these same nine items in the SSRS standardization sample
- σ = the standard deviation of the nine items in the SSRS standardization sample

Thus, the standardized (z-score) variable expresses each NLTS2 student's score in terms of its distance from general population's mean score, where the metric for the distance is the general population standard deviation. This variable has a range of -4.42 to 2.03, with a weighted mean of -0.34 and a standard deviation of 1.13.

- **Persistence.** Parents were asked how often youth kept "working at something until it is finished, even if it takes a long time." Response categories were "never," "sometimes," or "very often." The ability to persist with tasks to completion is expected to be positively associated with higher academic performance. Parents report that 16 percent of youth "never" persist, and 35 percent do so "very often."

Demographic Characteristics

The factors noted above suggest relationships between the nature of a youth's disability and his or her experiences. However, demographic characteristics also are associated with variations in academic achievement, both for youth with disabilities (Blackorby et al. 2003; Blackorby et al. 2004; Wagner, Blackorby, and Hebbeler 1993), and youth in the general population (Freeman 2004; Kao and Thompson 2003).

- **Age.** The large majority of youth in NLTS2 were ages 16 through 18 when the direct assessments and functional ratings were conducted. Because this is a fairly narrow age range and the standard scores used in the analyses take age into account, the differences in academic achievement for youth who are at the lower and upper ends of the range were expected to be relatively small, though potentially still significant. Differences could result if youth fall increasingly behind or increasingly advance as they age.
- **Gender.** In the general population, differences in the achievement of boys and girls in school are notable, generally favoring girls (National Center for Education Statistics, 2005d). Differences also have been noted for youth with disabilities, although the strength and direction of relationship are less consistent (Blackorby et al. 2003; Blackorby et al. 2004; Wagner, Blackorby, and Hebbeler 1993). Whereas youth in the general population are split about evenly between boys and girls, almost two-thirds of youth with disabilities in the NLTS2 age range are boys. Further, it also is clear that gender is intertwined with the nature of youth's disabilities, with males accounting for a much higher proportion of some disability categories (e.g., autism, emotional disturbances) than others (e.g., hearing or visual impairments) (Marder, Levine, and Wagner 2003). Including both gender and disability in multivariate analyses will enable their independent relationships to academic performance to be identified.
- **Racial/ethnic background.** Research has documented the relative disadvantage minority youth experience in the education domain (National Center for Education Statistics 2005d), as has prior research on youth with disabilities (Blackorby et al. 2003; Blackorby et al. 2004; Wagner, Blackorby, and Hebbeler 1993). Overall, 62 percent of youth with disabilities are White, 21 percent are African American, 14 percent are Hispanic, and 3 percent have other or multiple racial/ethnic backgrounds. However, this distribution varies across disability categories. For example, the category of mental retardation has a particularly large percentage of African Americans (33 percent), and the categories of other health impairment and autism have particularly small percentages of Hispanic students (8 percent and 9 percent, respectively) (Marder, Levine, and Wagner 2003). Again, multivariate analyses permit the relationships of these factors to academic performance for youth with disabilities to be assessed independently.

Household Characteristics

Although the variables described above were expected to do much to help illuminate differences in the academic performance of youth with disabilities, focusing on these variables alone would mistakenly imply that learning is related only to somewhat immutable characteristics that young people bring with them to school and would ignore the important role of household and family context in shaping the experiences of youth (Blackorby et al. 2003;

Henderson and Berla 1994). The following characteristics of the households of youth with disabilities were expected to relate to their academic performance in the ways noted below.

- **Household income.** Poverty has been shown to have serious negative consequences for children and youth as a whole (Duncan and Brooks-Gunn 1997) and for the achievements of youth with disabilities in secondary school (Blackorby et al. 2003; Blackorby et al. 2004; Wagner, Blackorby, and Hebbeler 1993). A similar pattern is predicted for the current NLTS2 analyses. One-fourth of youth with disabilities live in poverty, a higher rate than in the general population (20 percent, $p < .01$) (Marder et al. 2003). A reasonable proxy for poverty is annual household income, for which NLTS2 obtained categorical data in $5,000 increments, with a top category of $75,000 or more. Because the variable is not strictly continuous, it was included in the analyses as two dummy variables: low income (less than $25,000; 32.2 percent of the sample) and high income ($75,000 or more; 12.6 percent of the sample). The moderate income category is the omitted variable. Because low household income often is related to minority racial/ethnic status (Marder et al. 2003), including both household income and the racial/ethnic background of youth with disabilities in analyses will help disentangle their interrelationships.
- **Family support for education.** Parental support for learning is an important contributor to success in school for the general student population (Epstein 1996; Henderson and Berla 1994; Thorkildsen and Stein 1998) and for youth with disabilities (Blackorby et al. 2003). A similar association is expected for the current analysis. Two scales have been constructed to test this expectation. One scale, which assesses family involvement in education at home, is the frequency (on a 4-point scale) with which parents report helping youth with homework and talking with youth, and, a dichotomous variable indicating whether the family provides a computer at home that the student uses for educational purposes; summing responses to these items produces a scale ranging from 0 to 9, with a mean of 6.8. Family involvement at school is assessed with a second scale constructed by summing parents' reports (on a 4-point scale) of the frequency with which they did the following in the 2001-02 school year: "attend a general school meeting, for example, back-to-school night or the meeting of a parent-teacher organization"; "attend a school or class event, such as a play, sports event, or science fair"; or "volunteer at school, for example, chaperoning a class field trip or serving on a committee." The scale ranges from 0 to 12, with a mean of 3.3.
- **Family expectations.** Research has demonstrated that having clear, consistent, and high expectations for academic performance is related to student achievement for the general population (Thorkildsen and Stein 1998). Similar relationships have been found for students with disabilities (Blackorby et al. 2003) and were predicted to emerge in the current NLTS2 analyses. Parents were asked to report their expectations that their adolescent children with disabilities will "attend school after high school." Expectations for youth are generally high. Overall, 62 percent of parents expect youth "definitely" or "probably" to attend postsecondary school.

School Experiences

The analyses include several factors related to students' school experiences that have been shown to relate to academic achievement, as noted below. Because academic achievement is a product of students' cumulative experiences with schooling over time, the school-related factors in the analyses include some measures of past experiences (e.g., cumulative school mobility and grade retention over the school career). They also include measures of current performance at school that research suggests correlate with learning. Instructional experiences (e.g., instructional setting, curriculum modifications) are not included here because NLTS2 currently has only single-point-in-time measures of such factors, rather than data on students' overall school programs, which will come from transcripts collected when students have completed school; subsequent analyses can address relationships between school program factors and academic achievement.

- **Student mobility.** Research has demonstrated relationships between high rates of student mobility and poor school performance (Demie 2002; Rumberger 2002). These negative relationships may relate, at least in part, to the disruption and lack of continuity in students' learning experiences, which, for students with disabilities, may include compromised service coordination, the potential for poor communication between new and old schools and service systems, and inadequate record sharing (Kerbow 1996). For these reasons, parents' reports of the number of times students with disabilities have changed schools, other than because they were moving from one grade level to the next, are included in analyses. Values range from 0 to 8, with a mean of 1. Because this variable is skewed, to ensure that its inclusion as a continuous variable did not mask nonlinear effects, an alternate set of models also was estimated substituting a series of dummy variables for values 1 to 8 (with zero as the omitted category).
- **Grade retention.** The intention in making low-performing students repeat a grade is to provide an opportunity for them to master material missed in their first exposure to it at a given grade level, which may result in improved performance later in school. However, some research indicates that younger students with disabilities who were retained at grade level continue to exhibit lower academic performance than those who were not, independent of other differences between them (Blackorby et al. 2004). The current NLTS2 analyses include a measure of parents' reports of whether youth have ever been retained at grade level (36 percent had done so in Wave 1) (Wagner 2003) to explore this relationship for secondary school youth.
- **Grades.** Although performance on standardized tests receives the greatest attention in discussions of students' academic performance, teachers' evaluations of performance as indicated in course grades represent a common metric of student performance that often is tied more directly to the day-to-day business of teaching and learning than are annual standardized test scores. Grades communicate to students and parents information about students' mastery of course content. In high school, a passing grade also is the criterion for a course's contributing to accumulated credit for graduation, and grades provide information for consideration in college admissions. Parents were asked to report students' overall grades on a 9-point scale (mostly As, mostly As and Bs, mostly Bs, and so on). For youth with no parent interview, teachers were asked to report students' grades in their classes on the same 9-point scale. For students who, according to parents,

received such grades as "excellent," "good," "fair," and "poor" instead of letter grades, grades in this form were converted to correspond to the same scale as letter grades.[6] On this composite measure, 32 percent of students with disabilities receive mostly As and Bs, and 10 percent receive mostly Ds and Fs.

- **Absenteeism.** Absenteeism results in students' missing exposure to curriculum and instruction and can interfere with relationships, resulting in reduced learning and performance (Blackorby et al. 2003). Therefore, the number of days students are absent in a month, excluding suspensions and expulsions (which are accounted for in the behavior variable described below), is included in the analyses. Data for a student's absences, obtained from his or her school through the Student's School Program Survey, indicate students with disabilities miss an average of 2.6 days of schools in a 4-week period (standard error = 0.10); 14 percent miss 6 or more days (Newman, Davies, and Marder 2003).
- **Behavior at school.** The behavior of youth at school is a crucial element in their overall social adjustment. Not only is school the context in which many youth spend most of their day, it also is where they engage in the important activities of gaining academic knowledge; learning and practicing more generalized skills, such as problem solving, being on time, and following directions; and developing formative relationships with peers and adults. Research on poor behavior at school has linked it to poor motivation for learning, which in turn, has been shown to relate to poor academic performance (Anderman and Maehr 1994; Deci et al. 1992; Wiest, Wong, and Kreil 1998). Students whose behavior at school violates school norms typically are subject to disciplinary actions or, in some cases, to suspension or expulsion from school. School staff were asked whether youth had been suspended, expelled, or involved in any other type of disciplinary action, such as a referral to the office or detention, during the current school year, and a dichotomous variable was created indicating whether or not any of these had occurred. More than one-third of youth with disabilities (35 percent) are involved in one or more of these types of disciplinary action in a school year.

Accommodations During Testing

Youth who were reported to need them were given various accommodations during testing. The most frequent accommodation during group-administered testing—more time to complete the test—was not an issue during the NLTS2 assessment because the test was individually administered and not timed. However, as reported in chapter 2, some youth did take the assessment in multiple sessions or with breaks (8 percent); using American Sign Language (ASL) or with an ASL interpreter (8 percent); using Braille or large print materials (6 percent); with special furniture or lighting (5 percent); and/or using a calculator for the mathematics assessments (23 percent). To the extent that accommodations were given to all youth who needed them and "equalized the playing field" for those youth, no relationship with performance would be expected relative to youth who did not receive them because they did not need them. On the other hand, if the accommodations did not fully compensate for the impairment that necessitated the accommodation, a negative association could be found. Conversely, if the accommodations provided an extra advantage, one would expect to see positive associations.

[6] See appendix A for a description of the meshing of these grade measures.

The relationships these characteristics of individual youth with disabilities, their households, and their previous school experiences have with academic performance are presented in the following section.

Factors Related to the Academic Achievement of Youth With Disabilities

Multivariate analyses of the standard scores of youth with disabilities on reading comprehension, mathematics calculation, and content knowledge in science have identified the relationships described below between achievement and specific individual and household characteristics and previous school experiences, independent of other factors in the analyses (table 2).

Individual Characteristics of Youth

Disability Characteristics

Disability category. Multivariate analyses of categorical variables, such as disability category, require that individual categories be compared with a standard category that is not included as a variable in the analysis. For analyses related to disability category, the standard for comparison is the category of learning disability; it was chosen because it is the largest category and, thus, most closely resembles a comparison with youth with disabilities as a whole. Controlling for other factors, there is a significant amount of variation in the three measures of academic performance related to disability category differences. For example, youth with visual impairments or emotional disturbances score 7 and 5 points higher ($p < .05$) than youth with learning disabilities on passage comprehension, other factors held constant,[7] whereas youth with traumatic brain injuries, autism, multiple disabilities, or mental retardation score from 6 to 13 points lower.[8]

There is somewhat less variability in scores across disability categories with regard to mathematics calculation and science content knowledge, with scores of youth in four categories being significantly different from those of youth with learning disabilities. As with passage comprehension, youth with visual impairments averaged scores about 7 points higher than peers with learning disabilities on mathematics calculation ($p < .01$), although they did not differ in science content knowledge. Youth with hearing impairments also scored significantly higher than youth with learning disabilities on mathematics calculation (5 points, $p < .05$), yet averaged significantly lower scores on science content knowledge (8 points, $p < .01$).[9] Youth with multiple disabilities (including deaf-blindness) or mental retardation score lower than youth with learning disabilities on tests of both mathematics calculation and science content knowledge (ranging from 9 to 11 points, $p < .01$ and $p < .001$); youth with autism also score lower than those with learning disabilities on the measure of science content knowledge (10 points, $p < .001$).

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[7] A positive relationship also is noted for the use of synonyms/antonyms (appendix C, table C-2).

[8] Youth with autism, multiple disabilities, and mental retardation also score significantly lower than youth with learning disabilities on the three measures reported in appendix C; those with traumatic brain injuries show negative relationships to measures of applied problem solving and social studies content knowledge (appendix C, table C-2).

[9] Youth with hearing impairments also score significantly lower on the measure of social studies content knowledge (appendix C, table C-2)

Table 2. Factors associated with variation in the passage comprehension and mathematics calculation skills and science content knowledge of youth with disabilities

Independent variables	Change in the following scores for each unit change in the independent variable: Passage comprehension	Mathematics calculation	Science content knowledge
Disability characteristics			
Visual impairment (vs. learning disability)	**+6.55***	**+7.06****	+4.00
Emotional disturbance (vs. learning disability)	**+4.50***	+2.14	+0.41
Orthopedic impairment (vs. learning disability)	+3.26	-1.11	-0.01
Other health impairment (vs. learning disability)	+2.32	+1.99	+0.16
Speech/language impairment (vs. learning disability)	-1.27	+2.85	-2.23
Hearing impairment (vs. learning disability)	-3.79	**+4.85***	**-8.19****
Traumatic brain injury (vs. learning disability)	**-5.72***	-0.93	-3.88
Autism (vs. learning disability)	**-7.32*****	-2.21	**-9.77*****
Multiple disabilities/deaf-blindness (vs. learning disability)	**-8.00*****	**-9.29*****	**-9.32****
Mental retardation (vs. learning disability)	**-13.44****	**-11.15****	**-9.74*****
Age at identification of disability	**+0.42****	**+0.41*****	**+0.25***
Functioning			
Number of domains affected	**-0.86***	+0.38	**-0.83****
Functional cognitive skills	**+2.09*****	**+2.60*****	**+1.31*****
Social skills	**-1.16***	-0.79	-0.57
Persistence	-1.20	+0.74	**-1.47***
Demographics			
Age	-0.52	-0.77	-0.75
Gender (boys vs. girls)	+0.05	**+3.23*****	**+2.81*****
African American (vs. White)	**-8.46*****	**-8.33*****	**-10.63*****
Hispanic (vs. White)	**-11.80*****	**-5.21*****	**-12.76*****
Other or multiple race/ethnicity (vs. White)	**-10.48*****	**-8.77*****	**-10.23*****
Household characteristics			
Expectations for postsecondary education	**+6.18*****	**+6.32*****	**+4.64*****
Low income (vs. moderate income)	**-3.36*****	**-2.74****	**-4.74*****
High income (vs. moderate income)	+1.19	+2.03	-0.03
Family involvement at home scale score	-0.35	-0.51	-0.29
Family involvement at school scale score	+0.22	+0.21	+0.11
School experiences			
Ever retained at grade level	-1.33	-1.41	-0.55
Overall grades	-0.21	+0.12	+0.09
Had any suspensions, expulsions, or disciplinary actions in the current school year	+0.96	**-2.09***	-0.17
Days absent per month	-0.31	**-0.52****	-0.16
School mobility other than for grade level changes	+0.59	-0.12	+0.14

See notes at end of table.

Table 2. Factors associated with variation in the passage comprehension and mathematics calculation skills and science content knowledge of youth with disabilities—Continued

Independent variables	Change in following scores for each unit change in the independent variable: Passage comprehension	Mathematics calculation	Science content knowledge
Accommodations			
Breaks or multiple sessions	**-4.00****	-2.80	**-5.74*****
ASL or ASL interpreter	**-8.96*****	**-4.96****	**-8.25*****
Braille or large print materials	+4.50	+3.74	+3.50
Special furniture or lighting	-2.05	+1.56	+0.95
Calculator	†	**+3.94*****	†

† Not applicable; this accommodation was included only in models related to mathematics.

Multivariate analyses require that for categorical variables, such as disability category, each category be compared with another specified category. Learning disability was chosen as the category against which to compare the relationships for other disability categories because it is the largest category and, therefore, most closely resembles the characteristics of youth with disabilities as a whole. Similarly, White youth are the group against which to compare results for other racial/ethnic groups because it is the largest group.

*p < .05, **p < .01, ***p < .001. Note that approximately 100 relationships are included in this table; about 5 would be expected to be statistically significant by chance.

Table reads: The passage comprehension standard score of youth with visual impairments is 6.6 points higher than the score of youth with learning disabilities, other factors being equal. The mathematics calculation score of youth from low-income households is 2.7 points lower than the scores of youth from moderate income households, independent of other factors.

The performance across measures by youth in some categories is quite stable. For example youth with orthopedic, speech/language, or other health impairments consistently have scores that are similar to youth with learning disabilities,[10] and those with mental retardation have the lowest scores on all measures of achievement. In contrast, the performance of youth in some other categories varies markedly across the measures, as noted above for youth with hearing impairments, who score significantly higher and lower than youth with learning disabilities on two measures but are not significantly different on the third. Youth with emotional disturbances or traumatic brain injuries have scores that are not significantly different than youth with learning disabilities on mathematics calculation and science content knowledge,[11] but those with emotional disturbances score significantly higher (4 points, $p < .05$) and those with traumatic brain injuries score lower by 6 points ($p < .05$) on passage comprehension.[12]

Age at identification of disability. Having a disability that was identified at a later age is consistently associated with higher standard scores across the three measures, ranging from one-quarter to about one-half a point for each increasing year.[13] Thus, for example, a youth whose disability was first identified at age 9 is estimated to score about 2 points higher on mathematics

[10] Youth with orthopedic or speech/language impairments also score similarly to peers with learning disabilities on the three measures reported in appendix C; those with other health impairments outscore youth with learning disabilities on the use of synonyms/antonyms (appendix C, table C-2).

[11] Similarly, their scores do not differ from youth with learning disabilities on two of the three measures reported in appendix C.

[12] Youth with emotional disturbances also score higher than those with learning disabilities on the use of synonyms/antonyms, and youth with traumatic brain injuries score lower on social studies content knowledge.

[13] A similar relationship is noted for synonyms/antonyms and applied problem solving (appendix C, table C-2).

calculation and science content knowledge than a youth whose disability was identified at age 4, independent of other factors in the analyses.

Functioning

Number of functional domains affected by disability. The number of functional domains in which youth experience problems related to disability is significantly related to their achievement in reading and science content knowledge;[14] for each additional domain affected by disabilities there is estimated to be a 1-point decline in those two measures ($p < .05$ and $p < .01$, respectively).

Functional cognitive skills. A youth's functional cognitive skills are more consistently and strongly related to academic performance than the other functional abilities included in the analyses. Higher achievement across the measures[15] is apparent for youth with higher functional cognitive skills, ranging from 1 to almost 3 points for each 1-point gain in the scale score ($p < .001$ for all relationships). Thus, compared with youth whose functional cognitive skills scale score is 7, those with a score of 15 are estimated to have achievement scores that are from 11 to 21 points higher, independent of other factors in the analyses.

Other functional skills. In contrast to the consistent pattern of positive relationships between functional cognitive skills and academic achievement, scores measuring social skills and persistence in tasks each relates to only one of the measures of academic achievement in table 2, and both relationships are negative, contrary to expectations.[16] Specifically, there is approximately a 1-point decline in the passage comprehension standard scores associated with each additional 1-point score on the social skills scale and a similar decline in science content knowledge associated with each increasingly higher level of persistence ($p < .05$ for both relationships).

Demographic Characteristics

Age. None of the measures examined varies with the age of youth, all of whom were assessed when they were within a 16- through 18-year-old age range.[17]

Gender. Boys with disabilities outscore girls by about 3 standard score points on measures of both mathematics calculation ability and science content knowledge.[18] There is no significant difference in reading comprehension.

Race/ethnicity. Compared with White youth with disabilities, the academic performance of those in other racial/ethnic groups is markedly lower on all measures.[19] However, the patterns of performance across measures are not uniform for the three racial/ethnic groups. The performance

[14] This relationship also is apparent for synonyms/antonyms and social studies measures (appendix C, table C-2).
[15] Similar consistent and strong relationships are noted for other measures of academic performance (appendix C, table C-2).
[16] Social skills also have a similar relationship to the use of synonyms/antonyms (appendix C, table C-2); persistence is unrelated to measures reported in appendix C.
[17] A similar lack of relationship is apparent with measures reported in appendix C, table C-2.
[18] Similar relationships also are found in analyses of applied problem solving and social studies content knowledge (see appendix C, table C-2).
[19] This includes measures reported in appendix C, table C-2.

gap for African American youth with disabilities relative to White youth is fairly stable, ranging from 8 to 11 standard score points across measures ($p < .001$ for all relationships). In contrast, the gap between Hispanic and White youth with disabilities is about twice as large for reading and science (12 and 13 points, $p < .001$) than for mathematics (5 points, $p < .001$). The pattern for those in other or multiple racial/ethnic groups is similar to those of African American youth with disabilities ($p < .001$ for all relationships).

Household Characteristics

Parents' expectations for education achievements. The strongest relationships between household characteristics and measures of the academic achievement of youth with disabilities are found for parents' expectations of postsecondary education for their adolescent children with disabilities.[20] Youth with disabilities are estimated to score 5 or 6 points higher across the achievement measures ($p < .001$ for all relationships) with each successively higher level of parents' expectations, independent of other differences between them. Thus, for example, parents who report youth "definitely" are expected to attend postsecondary school are estimated to score 13 standard score points higher on mathematics calculation than youth whose parents think they "probably won't" enroll.

Household income. Having a low annual household income (i.e., $25,000 or less) is consistently and negatively related to academic achievement across measures. Independent of other differences between them, youth with disabilities in the low-income group have average scores that are 3 to 5 points lower across measures ($p < .01$ or $p < .001$ for all relationships) than those in the moderate income group (i.e., more than $25,000 to $75,000). In contrast, being in the high-income group (i.e., greater than $75,000) is not related to any of the three measures of academic achievement.[21]

Parents' support for education. Neither the level of parental support for education at home nor at school is associated with academic achievement in reading, mathematics, or science.[22]

School Experiences

Of the variety of school experiences examined in these analyses, only experience with disciplinary problems and absenteeism relate to academic achievement, and only with regard to mathematics calculation.[23] Those who were suspended, expelled, or subject to other disciplinary actions in the current school year average mathematics calculation scores that are 2 points lower than those who have not ($p < .05$). In addition, each day of absenteeism is associated with a half-

[20] Similarly strong and consistent relationships occur with the other measures of achievement (see appendix C, table C-2).

[21] Similar relationships are apparent for the measures reported in appendix C.

[22] A similar lack of relationship also is apparent regarding synonyms/antonyms, applied problems, and social studies content knowledge (table C-2, appendix C).

[23] Regarding measures reported in appendix C, the only relationship of school factors to achievement involves a negative association of absenteeism with the measure of applied problem solving.

point lower mathematics score ($p < .01$). There are no significant relationships between academic achievement and grade retention, grades, or school mobility.[24]

Accommodations Provided During Testing

Several of the accommodations normally provided youth with disabilities as part of their IEPs also were provided them when they participated in the direct assessment; in several cases, that provision is significantly related to variation in the resulting assessment scores. The strongest and most consistent relationships are apparent regarding the use of ASL or an ASL interpreter. Across measures, youth who received this accommodation scored from 5 to 9 points lower than youth who did not ($p < .01$ or $p < .001$ for all relationships), holding constant other differences between them, including the presence of a hearing impairment. Further, youth who took breaks during the assessment session or were assessed in multiple sessions averaged standard scores on reading comprehension and science content knowledge that were 4 and 6 points lower, respectively, than similar youth who completed the assessment without these accommodations ($p < .01$ and $p < .001$). In contrast to these negative relationships, using a calculator for the mathematics calculation subtest is associated with a 4-point higher score on that subtest, independent of other factors included in the models. No associations are apparent between academic achievement and the use of Braille or large print materials or accommodations related to furniture or lighting.

How Much Variation Is Explained by the Models?

The factors examined in multivariate analyses of WJ III direct assessment measures conducted in NLTS2 explain a statistically significant portion of their variation. Across the three measures of academic achievement, the $r2$ values (which measure the proportion of variation explained by the analysis) are .35 for passage comprehension and .38 for both mathematics calculation and .36 for science content knowledge.[25] Nonetheless, about two-thirds of the variation in these measures of academic achievement is attributable to differences between youth on other factors than those included in these analyses. Of the variation explained by the models, the large majority relates to the individual characteristics of youth with disabilities ($r2$ values ranging from .30 to .33). Household characteristics increase the amount of variation explained by .05 for each measure. School experiences and the provision of accommodations add no additional explained variation for any of the three measures beyond what is explained by individual and household characteristics.[26]

[24] In the alternate models, none of the dummy variables created from school mobility showed a significant relationship with any dependent variable.

[25] Values for synonyms/antonyms, applied problem solving, and social studies content knowledge are .46, .46, and .34, respectively.

[26] Added explained variation due to household characteristics is .07, .06, and .06 for synonyms/antonyms, applied problem solving, and social science content knowledge, respectively. Added explained variation associated with school experiences is .03 and.02 for measures of synonyms/antonyms and social studies content knowledge; no additional variation is explained in the measure of applied problem solving.

Summary

NLTS2 findings reinforce the fact that the academic achievement of youth with disabilities in reading, mathematics, science, and social studies is related to a complex array of factors that characterize youth, their households, and their school experiences. Individual factors are the most powerful in differentiating students on the basis of their academic achievement, with the most consistent relationships being apparent for racial/ethnic differences, favoring White youth. Variations in family characteristics also add to an understanding of patterns of academic achievement, with parents' expectations for the postsecondary education of their adolescent children with disabilities being consistently related to higher achievement and having a low household income consistently relating to lower achievement. The school experiences of youth with disabilities examined in these analyses show relatively few significant relationships with youth's academic achievement. Although using a calculator as an accommodation in testing is positively related to mathematics scores, when other accommodations relate significantly to academic achievement measures, the relationships are negative.

As noted earlier, the assessments analyzed in this chapter do not include all youth with disabilities; those for whom academic assessments were reported not to be feasible or appropriate were assessed using a checklist of abilities that was completed by each youth's teacher or another adult who could assess his or her performance in multiple domains. The results of these alternate assessments are described in the following chapter.