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Assistive Technology as a Predictor of General or Alternate Assessment Among Elementary-aged Students With Autism Spectrum Disorders

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The No Child Left Behind Act of 2001 specifically mandates that all students participate in the general assessment process or some form of alternate assessment as a measure of school accountability for student academic progress. Although levels of communication difficulties, intellectual impairment, and specific diagnoses such as autism spectrum disorders (ASDs) are correlated with increased probability of participating in alternate assessment methods, very little empirical research has focused on identifying predictors for students' assessment modality. Archival data from the Special Education Elementary Longitudinal Study (SEELS; 2005) were used to examine variables that predict whether elementary school students with ASD participated in the general or alternate assessment. Results indicated that receptive and expressive communication abilities appear to influence participation in the general vs. alternate assessment in tandem with access to assistive technology. Students with ASDs were approximately 2.71 times more likely to participate in the general assessment when they had access to assistive technology. Next, we performed a second, follow-up analysis for only ASD students with communication problems. The odds ratio value increased to 14.9 indicating that ASD students with communication problems that had access to assistive technology were almost 15 times more likely to participate in the general assessment than students with communication problems without access to assistive technology.

Keywords: assessment and recommendation practices, assistive technology, education

In order to facilitate school reform based on current legislation, large-scale educational assessment has become a widespread and mandatory strategy implemented to measure student academic progress and to evaluate whole-school yearly academic progress. The No Child Left Behind Act of 2001 (NCLB) specifically mandates that all students participate in accountability testing, including those with severe cognitive impairments (Hager & Solcum, 2005). As a measure of annual yearly progress (AYP), all students are expected to participate in the general assessment process, including those students that require testing accommodations such as assistive technology, use of a scribe, or prompting upon request such as by repeating the question. However, the Individuals with Disabilities Education Act of 1997 (IDEA) and its 2004 reauthorization both require that students with the most significant cognitive disabilities be assessed through an alternate means when necessary to accurately reflect what a student has learned. If the general assessment is not appropriate for an individual student who cannot be fully accommodated by taking the test under conditions that will allow them to demonstrate yearly academic change, then the education agency is required to provide an alternate assessment.

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The most common method for the determination of a student's participation in the general assessment is from a decision from the student's individualized education plan (IEP) team, taking into account their consideration of both curricular and state requirements (Thurlow, Lazarus, Thompson, & Morse, 2005). Recently, there has been considerable momentum towards the increased participation of students with disabilities in the general assessment since NCLB mandated the testing of every student as a provision of AYP. Positive outcomes for students who receive the general assessment over an alternate assessment include heightened levels of learning and achievement on par with the standards of the general population, greater access to the general curriculum leading to greater chances of retaining grade level appropriate information, and diplomas that reflect accountability both on the part of the student, and the system as a whole (Stodden, Galloway, & Stodden, 2003). However, states have varied substantially in the percentages of students who received alternate assessments (Thurlow et al., 2005), as well as in their standards of academic progress (Browder et al., 2005) due to the lack of overall regulation of the process or even a consensus of how to measure academic yearly progress through alternate assessment.

A review of literature documents these concerns regarding the validity of alternate assessments. When a student requires an alternate assessment, the measures must be devised to assess language arts and reading, math, and science (Browder et al., 2003; Yell, Drasgow, & Lowrey, 2005). Most commonly, states choose

to adopt alternate academic achievement standards (AAAS) that are intended to mirror the achievement standards required of the general population, but concerns about the validity of such assessments persist (Goldstein & Behuniak, 2011). As a result of ambiguity in the wording of IDEA, states still vary widely in what is considered an appropriate alternate assessment, with methods ranging from curriculum-based checklists and portfolios, to modified standardized testing similar to the testing for students in the general classroom (Quenemoen, 2008). This continued variation concerning what does and does not constitute an alternate assessment is a major hindrance to improving the validity of these assessments (Goldstein & Behuniak, 2011). Currently, the three most commonly used forms of AAAS in classrooms are checklists, portfolios, and performance assessments (Roeber, 2002; Towles-Reeves, Kleinert, & Muhomba, 2009).

Students with disabilities that participate in alternate assessments have a wide range of diagnoses, but patterns have emerged with regards to certain diagnoses increasing the probability that a child will participate in the general or alternate assessment process. Kearns, Towles-Reeves, Kleinert, Kleinert, and Thomas (2011) reported the primary categorical labels for students in alternate assessments across seven states as mental retardation (47.5%), multiple disabilities (22.6%), and autism (14.8%). The authors also reported that on average, 51% of pre-symbolic individuals (e.g., those using cries/facial gestures for communication), and 46% of emerging-symbolic individuals (e.g., those using gestures or pictures for communication) were using assistive technology in the form of augmentative and alternative communication (AAC). Access to AAC has shown not only increases in expressive and receptive communication for students with communication deficits, but also increased access to post-secondary opportunities that may have otherwise been unavailable to them (Burgstahler, 2006; Millar, Light, & Schlosser, 2006). A 2006 survey of 144 speech and language pathologists revealed that one-third of special education students using AAC were given a label of pervasive developmental disorder or autism (Binger & Light, 2006). Common forms of AAC seen in public schools include the picture exchange communication system (PECS) and various sound generation devices (SGD).

As the diagnoses and characteristics of students that take an alternate assessment are beginning to be delineated, a notable absence in the literature is an investigation into the predictors for students that participate in alternate assessments (Browder et al., 2003; Towels-Reeves et al., 2009). Goldstein and Behuniak (2011) suggested that sufficient access to assistive technology is an assumption of legislators and administrators with regards to students with special needs. Further, it is assumed that educators have a proper knowledge base to support students using such technology. Tager-Flusberg, Paul, and Lord (2005) report that a significant number of children with autism fail to ever develop speech (some estimates approach half of the population), highlighting the need for extensive application of AAC technology. However, Hess, Morrier, Heflin, and Ivey (2008) found that of 185 public school classrooms in the state of Georgia (USA), 12% were using assistive technology for students with ASDs, a concerning percentage considering the amount of language deficits reported previously. Ironically, assistive technology was reported as one of the top five accommodations used in educating children with autism and was the most frequently used skill-based intervention for this population. With such a critical need in the field of assistive technology for students with ASD, specific attention needs to be paid to the role of that technology in determining whether a student will receive the general or alternate assessment in their state (Hess et al., 2008; Kearns et al., 2011).

ASDs refer to a set of neuropsychological disorders with symptoms presenting by the age of three. The symptoms of ASDs entail core impairments in social interaction and communication often accompanied by restrictive, repetitive behaviors (American Psychiatric Association, 2000). As a result of this impairment in communication and subsequent social interaction, individuals with ASDs may require the use of assistive technology, specifically AAC devices. The current study, however, does not examine AAC devices exclusively but assistive technology in general as utilized by individuals with ASDs, which may include AAC devices as ASDs include core impairments of communication and social interaction. The purpose of the current study was to examine how access to assistive technology may predict the type of assessment participation when statistically controlling for a variety of background variables (e.g., ethnicity, gender, age, household income, cognitive functioning, adaptive functioning, and communication skills). This relationship is critical for examination given that the use of assistive technology is an accommodation in alternate or general testing and not a criterion for inclusion in the alternate assessment. Alternate assessments are intended for individuals with significant cognitive impairments (Browder et al., 2005; Goldstein & Behuniak, 2011) rather than issues communicating thus needing assistive technology. Thus, after controlling for level of intellectual or adaptive functioning, the use of AT devices should not be significantly associated with the participation in either the alternate or general assessment. Any association of AT device use and participation in the general assessment would suggest that access to AT devices may be more influential than intended by legislation. To achieve this purpose, data from a large, nationally representative, and community-based study were utilized.

Method

Sample

The Special Education Elementary Longitudinal Study (SEELS; 2005) is a nationally representative and community-based study commissioned by the Office of Special Education Programs (OSEP) and the U.S. Department of Education. Beginning in the 1999–2000 academic school year, the SEELS followed approximately 9,000 children who were eligible for special education services across the nation beginning in the 1999–2000 academic school year across a period of 5 years. The SEELS included 758 children with diagnoses of an ASD confirmed by schools upon parents' initial reports who participated in some form of assessment. Among the children with ASDs, approximately 17.3% ($n = 121$) were female and 82.7% ($n = 625$) were male. With regard to ethnicity, 67.6% ($n = 512$) identified themselves as White, 17.0% ($n = 129$) identified themselves as African American, 10.6% ($n = 80$) identified themselves as Hispanic, 3.8% ($n = 29$) identified themselves as Asian American, and

Table 1. Descriptive statistics of predictors according to type of assessment.

Predictors	*Min*	*M*	*Mdn*	*Max*	*SD*
Alternate assessment					
Adaptive behavior functioning	0.00	19.06	18.89	75.00	13.19
Woodcock Johnson III-R Academic Achievement					
Applied problems	0.00	15.67	15.66	75.00	9.52
Calculation	0.00	23.05	24.55	89.00	11.89
Letter-word identification	0.00	23.29	25.39	94.00	14.86
Passage comprehension	0.00	14.97	16.50	68.00	9.49
Expressive communication	1.00	2.68	3.00	4.00	0.88
Receptive communication	1.00	2.31	2.00	4.00	0.69
Age of assessment	7.00	10.82	11.00	14.00	1.58
General assessment					
Adaptive behavior functioning	0.00	20.06	19.07	125.00	9.24
Woodcock Johnson III-R Academic Achievement					
Applied problems	0.00	31.71	29.00	98.00	22.88
Calculation	0.00	38.68	37.11	98.00	20.60
Letter-word identification	0.00	39.04	37.22	97.00	22.92
Passage comprehension	0.00	28.49	26.36	94.00	20.29
Expressive communication	1.00	1.74	2.00	4.00	0.74
Receptive communication	1.00	1.92	2.00	4.00	0.64
Age of assessment	7.00	10.20	10.00	14.00	1.63

0.4% ($n = 3$) identified themselves as American Indian or Alaska Native. The average age of the time of the assessment was 10.30 years old ($SD = 1.76$). With regard to the dependent variable, type of assessment, approximately 50.3% ($n = 279$) of children with ASDs received the general assessment (with and without accommodations) while 49.7% ($n = 276$) received an alternate assessment. Approximately 21.3% ($n = 149$) of parents reported an income of less than $25,000 while 30.4% ($n = 212$) of parents reported an income between $25,000 and $50,000 and 48.3% ($n = 337$) of parents reported an income of more than $50,000. While school districts are generally responsible for providing assistive technology to students according to their IEPs, parents who have the disposable income may obtain assistive technology for their child on their own volition. Thus, we statistically controlled for the variable of household income as perhaps influencing access to assistive technology. The current study does not focus on household income but rather considers it an extraneous variable to be statistically controlled. Table 1 provides descriptive statistics according to type of assessment received. These demographic characteristics were equivalent by assessment type.

Measures

All measures were derived from the SEELS. The revised edition of the Scales of Independent Behavior-Revised (SIB-R; Bruininks, Woodcock, Weatherman, & Hill, 1996) was utilized to measure adaptive behavior functioning. Specifically, the raw score for the adaptive behavior full scale comprised of 14 subscales across 4 adaptive behavior clusters was utilized. To measure academic achievement, percentile scores from a revised, research edition of the Woodcock Johnson III (WJ-III-R; Woodcock, McGrew, & Mather, 2001) were utilized. WJ-III-R percentile scores for each subscale (e.g., applied problems, calculation, passage comprehension, and letter-word identification) were analyzed. Communication ability was measured in terms of both expressive and receptive abilities separately. The expressive communication ability was a 4-point measure of how clearly a child was observed to speak by the teacher, with values ranging from 1 = *student had no trouble speaking clearly* to 4 = *student did not speak at all*. The receptive communication ability was also a 4-point measure, which indicated how well child understood what people said, with values ranging from 1 = *student understood just as well as other children* to 4 = *student did not seem to understand at all*. Lower scores indicate better communication abilities on both measures. Access to assistive technology for the purposes of assessment was measured according to a dichotomous variable. Approximately 24% ($n = 547$) of the students with ASDs had access to assistive technology, which would include AAC devices but not exclusively, while the 76% ($n = 173$) did not. Table 1 contains the descriptive statistics for each predictor according to type of assessment.

Procedure

Analyses were performed in M*Plus* (v. 5.20; Muthén & Muthén, 2008). Values for missing data were handled using full information maximum likelihood (FIML). FIML may be considered superior to most single imputation methods for handling missing values (Enders & Bandalos, 2001). Approximately 12% ($n = 98$) of cases were missing on all variables in the current study while approximately 8% ($n = 60$) of cases were missing on the outcome variable of interest, type of assessment received. Multivariate outliers on both dependent variables were minimal and were retained in the analyses. A priori power analyses were performed in G* Power (Faul, Erdfelder, Lang, & Buchner, 2007) indicating an acceptable level of statistical power ($1 - \beta = 0.99$).

Weights were employed to produce accurate population estimates based upon sample characteristics by accounting for sampling errors due to random discrepancies between the true population and sample achieved (Hahs-Vaughn, 2005, 2006).

Analyses

First, a hierarchical logistic regression was conducted with the predictors outlined in Table 1. Regression analyses specify directionality of one variable predicting another in contrast to a correlation, which is bidirectional and does not specify which variable predicts another. Hierarchical regression analyses permit the researcher to introduce variables into blocks thereby statistically controlling for variables as entered logistic regression analyses were employed as our outcome variable of interest was dichotomous as individuals receiving a general or alternate assessment (Tabachinck & Fidell, 2007). In our analyses, we first statistically controlled for the variables of ethnicity, gender, income, age at the time of assessment, adaptive behavior functioning, and academic achievement, along with expressive and receptive communication ability in our first block of covariates. Statistical control refers to when the variance of a certain variable, such as household income, is partitioned out from the outcome variable of interest leaving the variance unexplained by household income, which could then be explained by some combination of other relevant variables and error. We then entered the variable of access to assistive technology in our second block in our hierarchical logistic regression to assess the power of this predictor above and beyond the first block of covariates. To assess model fit, the Cox and Snell *R*-squared value was evaluated as being a conservative estimate of model fit (Tabachinck & Fidell, 2007). Values for r^2 of 0.01, 0.09, and 0.25 and larger may be indicative of small, medium, and large, respectively, according to Gravetter and Wallnau (2010). In the examination of individual predictor variables, regression coefficients (*B*) and estimates of their standard errors (*SE*) were presented along with their respective levels of statistical significance. Odds ratios (e.g., $Exp\ (B) \approx e^B$) for each predictor variable were also reported.

Results

In evaluating model fit, an *R*-squared value of 0.30 was achieved indicating an acceptable level of model fit. We next examined individual regression coefficients and corresponding odds ratios for the model. The variables of applied problems of WJ-III, expressive communication, receptive communication, and access to assistive technology were all statistically significant at the 0.05 level or less. Applied problems was statistically significant yet small association with an odds ratio value of $e^B = 0.973$, $p = 0.003$ indicating a 3% decrease in the likelihood of participating in the general assessment whenever the applied problems scores decreased. The odds ratios for expressive and receptive communication ability were noteworthy ($e^B = 1.755$, $p = 0.003$ and $e^B = 3.755$, $p = 0.002$, respectively). Thus, students with ASDs were approximately 76% more likely to participate in the general assessment whenever expressive communication ability improved. Moreover, students with ASDs were approximately 3.75 times more likely to participate in the general assessment whenever receptive communication ability improved. For the variable in our second block, access to assistive technology was statistically significant at that 0.05 level ($p = 0.036$) such that as access to assistive technology increased, the likelihood of participating in the general assessment also increased. The odds-ratio of 2.71 indicates that students with ASDs were approximately 2.71 times more likely to participate in the general assessment when they had access to assistive technology. Summary statistics for each individual predictor in modeling type of assessment received among students with ASDs are presented in Table 2.

As a follow-up analysis, we performed a second, follow-up hierarchical logistic regression for individuals with teacher-reported communication problems. Individuals with communication problems were operationalized as individuals scoring a value of 3 or 4 on either the receptive or expressive communication scale ($n = 272$). Model fit revealed an *R*-squared value

Table 2. Summary statistics for hierarchical logistic regression.

Variable	*B*	*SE*	Odds ratio
Ethnicity	0.858	0.506	2.358
Gender	−1.059	0.589	0.347
Income less than $25,000[a]	−0.723	0.556	0.485
Income more than $50,000[a]	−0.752	0.457	0.472
Age of assessment	0.030	0.088	1.030
Adaptive behavior functioning	−0.013	0.018	0.987
Woodcock Johnson III-R Academic Achievement			
Applied problems	−0.027	0.010	0.973*
Calculation	−0.016	0.010	0.984
Letter-word identification	0.004	0.012	1.004
Passage comprehension	−0.013	0.013	0.987
Expressive communication[b]	0.563	0.207	1.755*
Receptive communication[b]	1.323	0.340	3.755*
Access to assistive technology	0.999	0.554	2.715*

[a]The reference category for household was the income level of $25,000 to $50,000.
[b]Both expressive and receptive communication variables were coded in the SEELS such that lower scores indicated better respective communication ability.
*$p < 0.05$.

Table 3. Summary statistics among those individuals with communication problems.

Variable	*B*	*SE*	Odds ratio
Ethnicity	0.437	0.384	1.548
Gender	−0.888	0.615	0.411
Income less than $25,000[a]	0.121	0.552	1.129
Income more than $50,000[a]	−0.338	0.698	0.713
Access to assistive technology	2.704	1.160	14.945*
Age of assessment	−0.084	0.161	0.920
Adaptive behavior functioning	0.031	0.037	1.031
Woodcock Johnson III-R Academic Achievement			
Applied problems	−0.011	0.022	0.989
Calculation	−0.010	0.020	0.990
Letter-word identification	−0.007	0.013	0.993
Passage comprehension	0.005	0.017	1.005

[a]The reference category for household was the income level of $25,000 to $50,000.
*$p < 0.05$.

Table 4. Descriptive statistics of predictors among individuals with communication problems.

Predictors	*Min*	*M*	*Mdn*	*Max*	*SD*
Alternate assessment					
Adaptive behavior functioning	0.00	18.59	18.36	65.00	14.67
Woodcock Johnson III-R Academic Achievement					
Applied problems	0.00	16.56	17.82	58.00	7.63
Calculation	0.00	23.77	25.13	73.00	9.62
Letter-word identification	0.00	23.69	25.93	89.00	12.88
Passage comprehension	0.00	15.46	17.14	67.00	8.22
Expressive communication	1.00	3.07	3.00	4.00	0.66
Receptive communication	1.00	2.51	3.00	4.00	0.67
Age of assessment	7.00	10.83	11.00	14.00	1.48
General assessment					
Adaptive behavior functioning	0.00	19.01	19.12	43.00	4.51
Woodcock Johnson III-R Academic Achievement					
Applied problems	0.00	26.35	27.87	95.00	21.89
Calculation	0.00	37.29	36.19	95.00	22.61
Letter-word identification	0.00	34.48	36.32	97.00	23.21
Passage comprehension	0.00	23.44	24.90	94.00	19.71
Expressive communication	1.00	2.46	3.00	4.00	0.76
Receptive communication	1.00	2.51	3.00	3.00	0.62
Age of assessment	7.00	10.22	10.00	14.00	1.81

of 0.21 indicating an acceptable level of model fit. Only one of the individual predictors, access to assistive technology, was statistically significant at the 0.05 level, $p = 0.012$. Importantly, the odds ratio value increased to 14.9. This result indicates that ASD students with communication problems that had access to assistive technology were almost 15 times more likely to participate in the general assessment than students with communication problems without access to assistive technology. Table 3 provides the summary statistics for each individual predictor in modeling type of assessment received among students with ASDs, while 4 provides the descriptive statistics of predictors among individuals with communication problems.

Discussion

In sum, results indicate that receptive and expressive communication abilities appear to influence participation in the general over alternate assessment in tandem with access to assistive technology. Alternate assessments are intended for students with significant cognitive impairments, thus after statistically controlling for level of intellectual or adaptive functioning, neither communication nor access to assistive technology should predict receipt of the general or alternate assessment. Specifically, students with ASDs were approximately 2.71 times more likely to participate in the general assessment when they had access to assistive technology. Next, we performed a second, follow-up analysis for only ASD students with communication problems. The odds ratio value increased to 14.9 indicating that ASD students with communication problems that had access to assistive technology were almost 15 times more likely to participate in the general assessment than students with communication problems without access to assistive technology. These findings indicate the important role of assistive technology in receipt of the general versus alternate assessment.

Archival data were extracted from the SEELS to examine variables that predict whether students with ASD participated in the general or a form or alternate assessment of academic yearly progress. After statistically controlling for ethnicity, gender, income, age at the time of assessment, adaptive behavior functioning, academic achievement, and expressive and receptive communication ability in our first block of covariates, we examined the role of ASD students' access to AT as a predictor of the students' participation in the general versus alternate assessment of academic yearly progress. Results of the first model indicated that receptive and expressive communication abilities would appear to influence the receipt of the general versus alternate assessment in tandem with access to assistive technology. In the first model, these predictors were the most powerful indicators of type of assessment received after statistically controlling for a variety of background variables previously enumerated. Thus, as these communication abilities improved and access to assistive technology increased, then the likelihood of a student with an ASD receiving the general assessment also increased.

In our follow-up on these analyses, we next narrowed the sample to only focus on students with ASD who had either receptive or expressive communication problems. After statistically controlling for the same background variables, results revealed access to assistive technology as the only significant predictor of type of assessment received. The variable of access to assistive technology revealed itself to be a powerful predictor of type of assessment received by students with ASDs when focusing on students with communication problems. This finding is striking given previous research showing level of functioning (e.g., level of intellectual impairment) to be an important variable correlated with the use of general vs. alternate assessment. The odds ratio for access to technology improved of 2.72 to 14.95 from the first

model to the second. These results indicate that access to assistive technology may be a powerful predictor of a student with an ASD participating in the general assessment when statistically controlling for a variety of background variables (e.g., ethnicity, gender, age, household income, cognitive functioning, adaptive functioning, and communication skills).

To our knowledge, the current study is the first empirical analysis of the relationship of access to assistive technology for students with ASD as a way to potentially increase access to and participation in general assessment of yearly academic progress. One of the most substantial limitations of the current study is that we were not able to determine what proportion of the ASD students were appropriately receiving access to assistive technology. While our results confirm that access to assistive technology increases the likelihood of students with ASD participating in the general assessment, we cannot assess whether the students that did not have access to assistive technology actually needed assistive technology to accommodate for a specific communication deficit. Unfortunately, this is a limitation of using the SEELS data set given that there is no designation of whether the students' individualized education plan or 504 plan specified that the student should have access to assistive technology accommodations during academic instruction and assessment of learning outcomes. Additionally, assistive technology as defined in the SEELS encompasses AAC devices but can also comprise of devices and equipment such as calculators and screen readers. Thus, while students with ASDs would appear to use AAC devices most frequently of all assistive technology by and large given impairments associated with communication, we should not overlook the role that other assistive technology devices and equipment may have for students with ASDs to aid in their participation in the general assessment. In sum, we cannot provide information regarding the type of AT devices available to students.

Even with the limitations associated with the SEELS data set, the current study is the first empirical analysis of predictors associated with students with ASD taking an alternate versus the general assessment of yearly academic progress. Future research should consider examining the relationship of particular assistive technology devices in accessing the general assessment according to disability category. In examining these relationships, we can determine the most effective assistive technology devices in improving access to the general assessment and subsequently the general curriculum. We posit that access to assistive technology and access to the general assessment are on parallel trajectories across time such that as access to assistive technology increases so should access to the general assessment. Funding for assistive technology would not appear to be immune to current fiscal disparities in educational settings thus precluding a leveling off or saturation of the predictive power of assistive technology in the near future.

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: American Psychiatric Association.

Binger, C., & Light, J. (2006). Demographics of preschoolers who require AAC. *Language, Speech, and Hearing Services in Schools*, *37*, 200–208.

Browder, D., Flowers, C., Ahlgrim-Delzell, L., Karvonen, M., Spooner, F., & Algozzine, R. (2005). How states implement alternate assessments for students with disabilities. *Journal of Disability Policy Studies*, *15*, 209–220.

Browder, D. M., Spooner, F., Algozzine, R., Ahlgrim-Delzell, L., Flowers, C., & Karvonen, M. (2003). What we know and what we need to know about alternate assessment. *Exceptional Children*, *70*, 45–61.

Bruininks, R. H., Woodcock, R. W., Weatherman, R. F., & Hill, B. K. (1996). *Scales of independent behavior-revised*. Itasca, IL: Riverside.

Burgstahler, S. (2006). The development of accessibility indicators for distance learning programs. *ALT-J Research in Learning Technology*, *14*(1), 79–102.

Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal*, *8*, 430–457.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175–191.

Goldstein, J., & Behuniak, P. (2011). Assumptions in alternate assessment: An argument-based approach to validation. *Assessment for Effective Intervention*, *36*, 179–191.

Gravetter, F. J., & Wallnau, L. B. (2010). *Essentials of statistics for the behavioral sciences* (7th ed.). Belmont, CA: Thomas Wadsworth.

Hager, K. D., & Solcum, T. A. (2005). Using alternate assessment to improve educational outcomes. *Rural Special Education Quarterly*, *24*, 24–30.

Hahs-Vaughn, D. L. (2005). A primer for using and understanding weights with national data sets. *The Journal of Experimental Education*, *73*, 221–248.

Hahs-Vaughn, D. L. (2006). Analysis of data from complex samples. *International Journal of Research and Method in Education*, *29*, 165–183.

Hess, K. L., Morrier, M. J., Heflin, L. J., & Ivey, M. L. (2008). Autism treatment survey: Services received by children with autism spectrum disorders in public school classrooms. *Journal of Autism and Developmental Disorders*, *38*, 961–971.

Individuals with Disabilities Education Improvement Act, Pub. L. No. 108-446, 118 Stat. 2647 (2004).

Kearns, J. F., Towels-Reeves, E., Kleinert, H. L., Kleinert, J. O., & Thomas, M. K. K. (2011). Characteristics of and implications for students participating in alternate assessments based on alternate academic achievement standards. *Journal of Special Education*, *45*, 3–14.

Millar, D.C., Light, J.C., & Schlosser, R.W. (2006). The impact of augmentative and alternative communication intervention on the speech production of individuals with developmental disabilities: A research review. *Journal of Speech, Language, and Hearing Research*, *49*, 248–264.

Muthén, L. K., & Muthén, B. O. (2008). *MPlus user's guide*. Los Angeles, CA: Author.

No Child Left Behind Act, Pub. L. No. 107-110, 115 Stat. 1425 (2001).

Quenemoen, R. (2008). *A brief history of alternate assessments based on alternate achievement standards* (Synthesis Report 68). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.

Roeber, E. (2002). *Setting standards on alternate assessments* (Synthesis Report 42). Minneapolis: University of Minnesota, National Center on Educational Outcomes. Retrieved from http://education.umn.edu/NCEO/OnlinePubs/Synthesis42.html

Special Education Elementary Longitudinal Study. (2005). *SEELS data documentation and dictionary: Introduction*. Washington, DC: U.S. Office of Special Education Programs.

Stodden, R. A., Galloway, L. M., & Stodden, N. J. (2003). Secondary school curricula issues: Impact on postsecondary students with disabilities. *Exceptional Children*, *70*(1), 9–25.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). New York, NY: Harper Collins.

Tager-Flusberg, H., Paul, R., & Lord, C. (2005). Language and communication in autism. In F. R. Volkamar, R. Paul., A. Klin, & D. Cohen (Eds.), *Handbook of autism and pervasive developmental disorders* (pp. 335–364). Hoboken, NJ: Wiley.

Thurlow, M. L., Lazarus, S. S., Thompson, S. J., & Morse, A. B. (2005). State policies on assessment participation and accommodations for students with disabilities. *The Journal of Special Education*, *38*, 232–240.

Towles-Reeves, E., Kleinert, H., & Muhomba, M. (2009). Alternate assessment: Have we learned anything new? *Exceptional Children*, *75*, 233–252.

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson psychoeducational battery–III* (WJ III). Itasca, IL: Riverside.

Yell, M. L., Drasgow, E., & Lowrey, K. A. (2005). No child left behind and students with autism spectrum disorders. *Focus on Autism and Developmental Disabilities*, *20*, 130–139.