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Predictors of Assessment Accommodations Use for Students Who are Deaf or Hard of Hearing

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Current accountability reform requires annual assessment for all students, including students with disabilities. Testing accommodations are one way to increase access to assessments while maintaining the validity of test scores. This paper provides findings from an exploratory logistic regression analysis of predictors of four accommodations used with students who are deaf or hard of hearing: extended time, test directions interpreted, test items interpreted, and test items read aloud. Predicting factors included state policy, educational setting, teacher perspectives, and student characteristics. The paper discusses implications for assessment policies and practices with students who are deaf or hard of hearing, particularly during an era of accountability reform.

Recent years have seen large changes in federal policies on the education of students with disabilities. Under the No Child Left Behind Act of 2001 (2002), there is a move towards greater transparency in who participates in state assessments and how effective schools are in bringing all students to proficiency in core academic areas. The primary method for including students with disabilities in assessments is through the use of accommodations. Accommodations practices, however, are complex and involve consideration of many factors, including student characteristics, teacher perspectives, and accommodations policies that vary from state to state (Cawthon, 2007). There is also a great deal of heterogeneity in the students with disabilities population. Students who are deaf or hard of hearing (SDHH), the focus of this study, are unique in that their disability has implications for English language and literacy development, as well as for access to instructional content. [1] The purpose of this study is to explore student, teacher, and contextual variables that may affect accommodations use by SDHH on statewide, standardized assessments.

1 In some states, "hearing impaired" is the legal definition of individuals who are deaf or hard of hearing. Definitions of D/deaf or hard of hearing vary by individual and reflect diverse hearing levels, preferred methods of communication and primary language. The term "students who are deaf or hard of hearing" will be used in this paper to refer to all groups combined.

Decisions regarding assessment accommodations need to take into account individual student characteristics [Individuals with Disabilities Education Act (IDEA), 1997]. Although SDHH are a diverse group, three important factors shape their linguistic and educational backgrounds: (a) language and literacy development; (b) communication in schools; and (c) presence of other disabilities. These factors affect both how students learn and how they participate in the assessment process.

There is a great deal of variability in language development for children with hearing loss. Children who are born with a profound hearing loss typically have a smaller receptive and expressive speech repertoire (Musselman, 2000). Individuals also vary in whether they have attended early intervention programs for language or speech development (Marschark, 1997). However, SDHH have the same capabilities to develop language in an *accessible* mode of communication. For example, although deaf children may have very little access to the phonetic structure of spoken language, they can be fluent in a signed language that uses a visual mode of communication. There are cultural aspects to language use for SDHH that go beyond simply using a visual modality to communication. When their primary language is American Sign Language, many students who are deaf or hard of hearing are part of a cultural and linguistic minority (Lane, 1999). Although classified as a disability for the purpose of NCLB and much of the relevant special education legislation [e.g. Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794), (Americans with Disabilities Act of 1990 (42 U.S.C. §§ 12101 et seq.)], deafness also has linguistic and cultural aspects that affect how some students experience educational reform.

Literacy development is an intensive area of research in deaf education (Schrimer & McGough, 2005). One reason for the focus on literacy is the longstanding difficulty pre-lingual deaf students have had learning to read (Paul, 1998). Reading includes both lower level (e.g. phonetics, word decoding, fluency) and higher level (e.g. comprehension) cognitive skills. SDHH tend to struggle with all aspects of reading (Loeterman, Paul, & Donahue, 2002). In the United States the average deaf student's reading level increases half a grade per year, leveling off at the third or fourth grade level as the student reaches adolescence (Paul, 1997; Schimmel, Edwards, & Prickett, 1999). These findings have been consistent over the past three decades (Qi & Mitchell, 2007). As students move into the upper grades, their ability to access grade-level content (both in class and on tests) may be limited by their reading proficiency.

SDHH make up a heterogeneous group that communicate in a variety of ways (Schirmer, 2000). Schools are required to provide access to quality instruction (IDEA, 2004). Depending on the educational setting and the needs of the student, instruction may be provided in American Sign Language (ASL), Cued Speech, Total Communication (a combination of signs and speech), spoken English, or spoken English with an interpreter (Marschark, Lang, & Albertini, 2002). Accommodations made for instruction are the foundation for decisions about accommodations made for testing (IDEA, 2004). For example, if a student learns math primarily through spoken English, it is likely that the student will also be tested in English. For students who learn using a language other than English, there may be challenges in translating content on a standardized test that is written in English. When studying accommodations use for

SDHH, it is therefore important to know what language was used in instruction.

Many students whose primary disability is deaf or hard of hearing also have other disabilities. Approximately 40% of students counted in the 2003-04 Gallaudet Annual Survey were listed as having an additional disability including learning disabilities, cerebral palsy, mental retardation, emotional disturbance, and attention deficit disorder (Gallaudet Research Institute, 2005). Although each individual disability may not be considered severe, a student with multiple disabilities may face challenges in participating in assessments that one with only hearing loss may not. Thus far, there is little research that specifically investigates assessment practices for SDHH with additional disabilities (Cawthon & the Online Research Lab, 2006). This factor contributes to the heterogeneity of SDHH and the complexity of assessment accommodations decision-making process.

Assessment Accommodations

For many students with disabilities, participation in statewide, standardized assessments may require the use of *assessment accommodations* (Lazarus, Thurlow, Lail, Eisenbraum, & Kato, 2006). The purpose of assessment accommodations is to increase access to test content by removing barriers that stem from the standardized test format. Accommodations are designed to remove factors that penalize students because of their disability resulting in assessment scores that do not represent their content knowledge (Elliott & Braden, 2000; Phillips, 1994; Shriner & De Stefano, 2003). The *Standards for Educational and Psychological Testing* (American Educational Research Association, American Psychological Association, National Council on Measurement in Education [AERA, APA, NCME], 1999) describes all test changes as 'accommodations.' However, all accommodations are not considered equal in their ability to produce valid test scores (Koretz & Barton, 2003). For example, some accommodations may change the test item and make it easier or more difficult than if the student did not have the accommodation. These changes affect the validity of the assessment insofar as it is possible to measure student proficiency on content standards. Valid assessments are critical in a high-stakes assessment system where decisions about school quality depend on student performance. Decisions regarding accommodations use are therefore an important component of how students with disabilities fully participate in an accountability framework (Quenemoen, Lehr, Thurlow & Massanari, 2001).

Four assessment accommodations are discussed in this analysis: extended time, test items read aloud, interpreter for directions, and test items interpreted (see Table 1). These accommodations were chosen because they are either widely used in assessments for students with disabilities as a whole (Bolt & Thurlow, 2004) or because teachers recommend them for SDHH (Cawthon & the Online Research Lab, 2006; 2007). The first two, extended time and test items read aloud, are used with students who have a variety of disabilities, including SDHH (Cawthon, 2007). Two additional accommodations, interpreter for directions, interpreter for test items, are unique in that they use sign language (American Sign Language, cued speech, Signed Exact English, or other sign system used by the student) as part of test administration.

Table 1
Accommodations Definitions

Accommodation[a]	Definition
Extended time	Student is given additional time to complete the test. This may be time and a half, double time, or unlimited time.
Test items read aloud	The test questions are read aloud to the student.
Interpreter for directions	The directions portion of the assessment is presented to the student via sign language (or other version such as cued speech, signed English, etc.).
Interpreter for test items	The test questions are given to the student in sign language (or other version such as cued speech, signed English, etc.).

[a] *Source*: Clapper, Morse, Lazarus, Thompson, and Thurlow (2005).

Contextual Variables Affecting Accommodations Use

This analysis takes a multi-level approach to variables that might affect accommodations use. In addition to the academic proficiency and communication characteristics of SDHH, predictors such as accommodations policies, educational setting, and teacher perspectives each play a role in determining assessment practices.

Accommodations policy. NCLB legislation encourages states to develop clear accommodations guidelines that maximize the number of students that participate in standardized assessments while minimizing concerns regarding the validity of accommodated scores. Clapper et al. (2005) examined states policies for how implementing accommodations on state wide standardized assessments and implications for including student scores into accountability decisions for schools and districts. Their summary designated four policy categories, ranging from allowing the accommodation and using the score for accountability to prohibiting the use of the accommodation altogether. Accommodations such as extended time were allowed in most states whereas those that changed the presentation of test items (e.g. read aloud or interpreted) were more likely to result in restrictions on how the accommodated score could be used in accountability decisions. Cawthon (2007) showed the potential differential effect on students across the United States. Of teachers across the country who used extended time with SDHH, 57% lived in states where it was allowed in state policy. In contrast, of teachers with students who used test items interpreted, only 20% of them lived in states where it was allowed. The policy context specific to each accommodation is an important consideration when investigating predictors of accommodations use.

Classroom setting. A central question for parents when raising a deaf or hard of hearing child is where he or she should attend school (Fiedler, 2001; Marschark, 1997). In the United States, deaf education has a history of specialized educational

settings for SDHH (Van Cleve & Crouch, 1989). Today, SDHH learn in a variety of settings. *Schools for the Deaf* are typically stand-alone programs that sometimes include a residential component. *District and school programs* for SDHH tend to bring together students on a regional basis, providing either stand-alone education or partial integration into an adjacent regular education setting. Finally, *inclusive education* models focus on providing support services, if necessary, to an individual student within the general education setting. Support services can include interpreters, itinerant teachers of the deaf, or some pull out services during the school day to reinforce instruction by the regular education teacher (Stewart & Kluwin, 2001). While there is often overlap between these three models, such as a school for the deaf providing regional or itinerant services, this analysis investigated accommodations use in these three settings.

Teacher perspectives. Teacher views about accommodations affect the decisions they make about how students with disabilities participate in large-scale assessments (De Stefano, Shriner, & Lloyd, 2001). Teachers focus on how easily accommodations can be implemented and the potential threat to validity for accommodated scores (Bryant, Dean, Elrod & Blackbourn, 1999). When accommodations are viewed as appropriate, teachers are most likely to use accommodations that are easy to use during testing. Teachers of SDHH are also generally in favor of using accommodations for their students, indicating that accommodations are largely easy to implement and that accommodated scores are valid for use in accountability frameworks (Cawthon & the Online Research Lab, 2006, 2007).

Although overall views are generally positive, teacher perspectives may vary by the specific accommodation. For example, McKevitt and Elliott (2003) included surveys of teacher perspectives in their study of read aloud accommodations. Teachers, on the whole, used accommodations they felt were valid. However, teachers had some concerns about the validity of read aloud accommodations for reading assessments. Teachers expressed similar concerns in their description of best practices for SDHH (Cawthon & the Online Research Lab, 2007). They felt that read aloud and interpreted test item accommodations were a threat to validity for assessments in reading and language arts, but not for math tests. They also indicated that student language proficiency was an important factor in the validity of accommodations use. Teacher perspectives on accommodations use may therefore be specific to the type of accommodation, test subject, and student characteristics.

Study Objective

Results from the first two years of the *National Survey of Assessments and Accommodations for Students who are Deaf or Hard of Hearing* indicate that SDHH largely participate in assessments and do so using a range of accommodations (Cawthon & the Online Research Lab, 2006, 2007). Although the current literature gives an overall snapshot of accommodations use with this population, it is unclear how different contextual factors influence assessment practices. The purpose of this paper is to explore whether student characteristics, teacher perspectives, and contextual factors predicted accommodations use with SDHH.

Method

Participants

Data for this study are drawn from the *2nd National Survey of Assessments and Accommodations for Students who are Deaf or Hard of Hearing (National Survey)*. The descriptive results of accommodations use from this study were published in Cawthon and the Online Research Lab (2007). Initial discussion of potential policy implications can be found in Cawthon (2007). A total of 414 teachers and/or district administrators from inclusive educational settings, schools for the deaf or hard of hearing, and district or regional programs participated in this survey. The sample of participants from schools for the deaf and district or regional programs was not random; all known schools and programs serving SDHH were contacted to participate in the study (Cawthon, 2006; Gallaudet Research Institute, 2005). Participants from inclusive settings learned of the study through a variety of awareness raising methods. For example, contacts were made through SDHH website affiliations, state lists of SDHH programs and services, and 687 personal postcard invitations to previous study participants (see Cawthon, 2006, for a detailed description of this snowballing technique). Most of the respondents preferred completing the online version of the survey (89%) rather than the paper version of the survey (11%).

Each respondent reported on a group of students that they served or taught in the 2004-05 school year, making the participant the primary unit of analysis. Respondents were primarily teachers of the deaf (48%) or regular education, special education, or itinerant teachers (20% total). Respondents also included administrators such as assessment coordinators (7%) and those who served in multiple roles (6%). Professionals who serve SDHH often take on multiple roles, particularly within regional programs. The remaining participants were interpreters, speech-language pathologists, school psychologists, and other professionals who work with SDHH. In this discussion, the terms "participants" and "teachers" refer to the respondents as a whole.

Teachers in this study served just over 9,500 students nationwide; this is approximately 13% of the estimated 70,000 SDHH in the United States who receive special services under IDEA (IDEA Child Count, U.S. Department of Education, 2003). The representativeness of this sample varied by Census region. A total 10% of the students in the *National Survey* were from the Northeast Census region, compared with 18% of the IDEA Child Count estimates of the DHH student population (Mitchell, 2004). Students of study participants from the Midwest region made up 22% of the sample, compared with 23% in the IDEA Child Count estimates. Due in part to recruitment procedures that relied on existing databases of schools and program contacts, the sample was heavily weighted towards students in the South Census region (43%). This is a higher concentration of students in the South than in the IDEA Child Count (31%). Finally, 24% of the students served by study participants came from the West census region, compared with 25% in the national estimate.

Analysis

Variable Definitions

Student characteristics. Student characteristics included the following variables: number of SDHH per respondent, grade level, percentage of students with severe or profound hearing loss, communication mode used in instruction, and whether students had additional disabilities. Each participant reported the number of students per grade (K-12) served in the 2004-05 school year. In order to use the data in a logistic regression, the number of SDHH was divided into one of four categories: 1 – 5, 6 – 10, 11 – 20, and 20 or more students served. Each category represents approximately 25% of the responses. For the grade level variable, the number of SDHH served by grade range was recoded into dichotomous variables of (0) = participant did not serve and (1) = participant served students in each grade range: elementary (Kindergarten-5th grade), middle (6th-8th grade), and high school (9th-12th grade).

Level of hearing loss can have a significant impact on the language development of SDHH. For example, students with more profound hearing losses are more likely to use sign language than those with mild losses who rely more on amplified speech to communicate. Because many accommodations in this study involve changing the language used (e.g. having the test directions interpreted or having the student sign their response), we included a variable to represent the percentage of students in the classroom with severe or profound hearing loss. Teachers reported the number of SDHH with mild, moderate, severe, and profound hearing loss that they served in 2004-05. This information was recoded into one continuous criterion variable identifying the percentage of SDHH who had severe or profound hearing loss served by each participant. Communication modes for instruction were included as candidate predictors in the logistic regression models. The communication modes included American Sign Language (ASL), other signed language, oral (speech) only, oral and signed language together (total communication), and oral by instructor with an interpreter. Each was coded as (0) = did not use in instruction and (1) = did use in instruction.

Additional disability was the last student characteristic used in the logistic regression models. The variables indicated whether or not the participant had at least one student with a learning disability, cognitive disability, Cerebral Palsy, was emotionally disturbed or was deaf-blind. These were coded dichotomously with (0) = participant did not have a student with this disability and (1) = participant had at least one student with this disability.

Teacher characteristics. There were two teacher characteristic measures in this analysis. The first scale measured the teachers' perception of how easy it is to use each accommodation (Cawthon & the Online Research Lab, 2007). This was drawn from previous research that teacher ratings on ease of use affect their choices about accommodations for their students (McKevitt & Elliott, 2003). The question read, "This question asks about the ease of use for the selected accommodations. Thinking of your students who are deaf or hard of hearing from the 2004-05 school year, how easy would it be to use the following accommodations?" Respondents rated the ease

of using each accommodation on a 5-point Likert scale (1 = *very difficult*, 2 = *fairly difficult*, 3 = *neither easy nor difficult*, 4 = *fairly easy*, 5 = *very easy*, and 6 = *no opinion*). Then, using a similar scale, respondents rated how well the accommodation reduces the barriers for the student without changing the validity of the test score: "This question asks for your thoughts on the validity of selected accommodations. Validity refers to the extent to which the accommodation reduces barriers to meaningful participation without changing the content of the test. A valid assessment is one that can be used to compare test scores with those of other students. Thinking of your students who are deaf or hard of hearing from the 2004-05 school year, how valid would it be to use the following accommodations?" For both questions, the "no opinion" responses were not included in the analysis because these individuals did not have students who used the specific accommodation on the statewide, standardized assessment.

Contextual characteristics. The contextual characteristic variables included educational setting and state policy on accommodations use. Educational setting was the first contextual characteristic used in the regression. Participants chose one of the following options: schools for the deaf, district or regional programs, or inclusive settings. Each setting was dichotomously coded so that the setting chosen was compared to all other settings. For example, if the participant taught students at a school for the deaf, this category was coded as (1) and district or regional programs and inclusive settings were both coded as (0). In this way, each setting could be used as an independent predictor in analysis.

The last set of criterion variables identified state policy for assessment scores taken with each accommodation. The policy variables were adapted from the *National Center on Educational Outcomes* report on state policies on assessment accommodations (Clapper, et al., 2005). Clapper, et al. analyzed state accommodation policies and created the following four categories: *Allowed* (A), *Allowed with implications for scoring and/or aggregation* (AI), *Allowed in certain circumstances* (AC), and *Prohibits* (P). The analysis in this study adds a fifth category, *Allowed with implications for scoring and/or aggregation and Allowed in certain circumstances* (AIAC). The state policy fields were merged into the *National Survey* database by state of residence for each participant, allowing us to summarize state policy on accommodation use for their students. For example, many states *Allow* extended time to be used in assessment. In these states, the state policy variable for extended time was coded so that A = (1) and the remaining policy categories were coded with (0).

Dependent Variables

Participants in this study provided information about the type of accommodations used by DHH students in 2004-05 state standardized assessments (descriptive data reported in Cawthon & the Online Research Lab, 2007). For each of the four accommodations under investigation, participants indicated whether at least one of their students received that accommodation for math, reading, or whether it was not used at all. Responses for each accommodation were transformed into a dichotomous variable: (0) = none of the students received the accommodation or (1) = at least one student received the accommodation in reading or math, or both.

Data Reduction and Missing Cases

To control for over-fitting the regression models, we used the following formula to calculate the number of allowable candidate predictor variables: $p < m/10$, where p is the number of candidate predictors and m is the number of cases required in each group of the dependent variable (Harrell, 2001). As a result, the maximum number of candidate predictor variables that could be used was eight for extended time accommodation, 13 for test items read aloud, eight for test directions interpreted, and 14 for test items interpreted.

We then addressed missing data for the candidate predictor and dependent variables. Each of the dependent variables was tested for randomness in relation to each of the candidate predictor variables (Tabachnick & Fidell, 2007). In addition, the SPSS Missing Value Analysis module was used to identify which of the remaining candidate predictor variables were most likely to be randomly missing (SPSS Training, 2001). If the missing data was found to be significantly different from the present data ($\alpha < .05$), we excluded the candidate variable from the study. For candidate and dependent variables used in the analysis, NORM software was used to perform multiple imputations to replace the missing data (Schafer, 1999). The percent of cases imputed ranged from six percent for student grade level to 24% for the percent of students with severe to profound hearing loss.

Each model was then screened for assumption violations. First, we screened for the multicollinearity assumption by ensuring that the standardized Beta coefficients were less than one and that the tolerance statistics were all greater than .01 for each candidate predictor (George & Mallery, 2006; Pallant, 2005; SPSS Training, 2001; Tabachnick & Fidell, 2007). The results indicated that none of the criterion variables in any of the models were found to be too high correlated. Second, multivariate outliers were examined using Mahalanobis' Distances (Mertler & Vannatta, 2002). Outliers are identified using chi-square values that are significant at $p < .001$. Any respondent Mahalanobis' Distances value exceeding the chi-square value was excluded from the analysis. The number of outliers removed ranged from no cases for test directions interpreted to eight cases for extended time.

Results

The following results are from direct logistic regressions of predictors of accommodation use with SDHH. This logistic regression analysis examined three main categories of variables: student, teacher, and contextual characteristics. This analysis produces an odds ratio to determine the strength of the effect of predictors on outcomes (Pampel, 2000; Tabachnick & Fidell, 2007). The odds ratio is a way of comparing whether the probability of a certain event is the same for two outcomes of a single predictor. In these results, odds ratios show the relatively likelihood of using an accommodation when the predictor is present (such as a state policy that allows the accommodation) versus when it is absent. An odds ratio of 1.0 indicates equal likelihood of occurring in either outcome. As the odds ratio becomes larger than 1.0, the outcome is more likely to occur in one condition than in the other. All results are significant at $p < .001$ unless otherwise indicated.

Extended Time

Table 2 shows the logistic regression coefficient, Wald test, and odds ratio for each of the variables significantly predicting the extra time accommodation (ET). A test of the full model with all eight predictors against a constant-only model was statistically significant, $X^2(8) = 43.589$, indicating that the predictors, as a set, reliably distinguished between ET use and non-use. Although the Hosmer-Lemeshow inferential goodness-of-fit test was significant, $X^2(8) = 24.430$, $p = .002$, the Wald criterion still indicates a good fit for this test. According to the Wald criterion, the presence of a learning disability, $X^2(1) = 5.796$, $p = .016$, SDHH who were also blind, $X^2(1) = 6.189$, $p = .013$, the attitude that using the ET accommodation is valid, $X^2(1) = 17.144$, $p < .001$, and the instructor communicated orally with an interpreter, $X^2(1) = 4.743$, $p = .029$, reliably predicted ET accommodation use.

Table 2
Direct Logistic Regression Indicating the Predictors of Extended Time Use

Predictor	Beta Coefficient	Wald X^2	Odds Ratio	95% CI for Odds Ratio	
Learning Disability	.720	5.796	2.055*	1.143	3.695
Deaf and Blind	1.059	6.189	2.885*	1.252	6.646
Validity of Use	.760	17.144	2.137***	1.492	3.062
Oral by Instructor with Signed Language by Interpreter	-.668[a]	4.743	.513*	.281	.935
Constant	-2.030	4.042			

Note. *$p < .05$, ***$p < .001$.

[a]When odds ratios are negative the inverse odds ratio (i.e. 1/logg odds) is calculated to interpret the impact of the predictor variable on the outcome (DesJardins, 2001). These are interpreted as the inverse of the positive odds ratios (so in this case, *absence* of oral with sign language by interpreter led to *greater* use of the extended time accommodation).

Test Items Read Aloud Accommodation

Table 3 shows the logistic regression coefficient, Wald test, and odds ratio for each of the variables significantly predicting test items read aloud (TIR) accommodation use. A test of the full model with all thirteen predictors against a constant-only model was statistically significant, $X^2(13) = 81.221$, indicating that the predictors, as a set, reliably distinguished between TIR use and non-use. The Hosmer-Lemeshow inferential goodness-of-fit test was insignificant, $X^2(13) = 4.677$, $p = .791$. According

to the Wald criterion, the presence of serving the K – 5 elementary grades, $X^2(1) = 17.780$, SDHH who were also learning disabled, $X^2(1) = 4.676$, $p < .05$, SDHH who were also blind, $X^2(1) = 4.110$, $p < .05$, the attitude that using TIR is easy, $X^2(1) = 12.722$, and the attitude that using TIR is valid, $X^2(1) = 11.991$, $p < .01$, reliably predicted TIR accommodation use.

Table 3
Direct Logistic Regression Indicating the Predictors of Test Items Read Aloud Use

Predictor	Beta Coefficient	Wald X^2	Odds Ratio	95% CI for Odds Ratio	
Elementary Grades (K-5)	1.079	1.079	2.943***	1.782	4.860
Learning Disability	.618	.618	1.855*	1.060	3.247
Deaf and Blind	.677	.677	1.969*	1.023	3.789
Ease of Using TIR	.364	.364	1.439***	1.178	1.758
Validity of Using TIR	.353	.353	1.423**	1.165	1.739
Constant	-3.028	-3.028			

Note. *$p < .05$, **$p < .01$, ***$p < .001$.

Test Directions Interpreted Accommodation

Table 4 shows the logistic regression coefficient, Wald test, and odds ratio for each of the variables significantly predicting test directions interpreted (TDI) accommodation use. A test of the full model with all eight predictors against a constant-only model was statistically significant, $X^2(8) = 111.190$, indicating that the predictors, as a set, reliably distinguished between TDI use and non-use. The Hosmer-Lemeshow inferential goodness-of-fit test was insignificant, $X^2(8) = 13.170$, $p = .106$. According to the Wald criterion, district or regional educational settings, $X^2(1) = 4.390$, $p < .05$, the percent of students with severe or profound hearing loss, $X^2(1) = 19.281$, and the attitude that using the TDI accommodation is easy, $X^2(1) = 47.705$, reliably predicted TDI accommodation use.

Test Items Interpreted Accommodation

Table 5 shows the logistic regression coefficient, Wald test, and odds ratio for each of the variables significantly predicting test items interpreted (TII) accommodation use. A test of the full model with all fourteen predictors against a constant-only model was statistically significant, $X^2(14) = 130.845$, indicating that the predictors, as a set, reliably distinguished between TII use and non-use. The Hosmer-Lemeshow inferential goodness-of-fit test was insignificant, $X^2(14) = 10.686$, $p = .220$. According to the Wald criterion, the presence of learning disabled DHH students, $X^2(1) = 7.563$, $p = .006$, the instructor used of a different form of oral communication, $X^2(1) = 10.241$,

Table 4
Direct Logistic Regression Indicating the Predictors of Test Directions Interpreted Use

Predictor	Beta Coefficient	Wald X^2	Odds Ratio	95% CI for Odds Ratio	
District or Regional Program	.659	4.390	1.933*	1.043	3.581
Percent with Profound or Severe Hearing Loss	2.070	19.281	7.928***	3.146	19.975
Ease of Using TDI	.961	47.705	2.614***	1.990	3.433
Constant	-4.707	29.814			

Note. *$p < .05$, ***$p < .001$.

Table 5
Direct Logistic Regression Indicating the Predictors of Test Items Interpreted Use

Predictor	Beta Coefficient	Wald X^2	Odds Ratio	95% CI for Odds Ratio	
Learning Disability	.797	7.563	2.218**	1.257	3.914
Oral Only Instruction	-.893 [a]	10.241	.409**	.237	.707
Ease of Using TII	.582	31.192	1.789***	1.459	2.194
Validity of Using TII	.439	19.446	1.551***	1.276	1.886
Percent with Profound or Severe Hearing Loss	1.673	13.962	5.330***	2.216	12.822
State Policy Allows TII	1.205	10.651	3.337**	1.618	6.881
State Policy Allows TII in Certain Circumstances	.849	6.807	2.338**	1.235	4.427
Constant	-4.869	40.749			

Note. **$p < .01$, ***$p < .001$.
[a] When odds ratios are negative the inverse odds ratio (i.e. 1/logg odds) is calculated to interpret the impact of the predictor variable on the outcome (DesJardins, 2001). These are interpreted as the inverse of the positive odds ratios (so in this case, *absence* of oral only instruction led to *greater* use of the test items interpreted accommodation).

the attitude that using TII is easy, $X^2(1) = 31.192$, the attitude that using TII is valid, $X^2(1) = 19.446$, the percent of severely or profound hearing loss, $X^2(1) = 13.962$, the state policy of allowing TII use, $X^2(1) = 10.651$, and the state policy of allowing

TII use in certain circumstances, $X^2(1) = 6.807$, $p = .009$, reliably predicted TII accommodation use.

Discussion

These exploratory findings illustrate how a range of variables might predict the use of accommodations for students who are deaf or hard of hearing. This discussion will first address important limitations of this dataset. We will then turn to predictors at the student, teacher, and contextual levels. This discussion concludes with implications within the context of high-stakes assessment practices and the NCLB accountability framework.

Limitations

There are several limitations in this data set that need to be taken into consideration when discussing the results. First, there were missing data in the candidate predictor and outcome variables for each accommodation model. For example, if a respondent did not provide the number of students who had profound hearing loss, the record would have missing data for this variable across all accommodations. The second limitation is the restriction placed on the number of candidate predictor variables. Limiting the number of candidate predictor variables is critical to avoid over fitting of the data (Harrell, 2001; Peduzzi et al., 1996). However, this results in fewer candidate predictors that can be loaded into each model. The third limitation is the unit of analysis in this data set. Participants reported on accommodations use when it applied to at least one of the students that they taught or served. The data therefore do not reflect accommodations use for individual students. Finally, the models included three variable levels: student, teacher, and contextual characteristics. There are certainly variables within each of these categories that were not gathered in the *National Survey*. For example, it could be that professional development is a teacher characteristic that would be important in predicting accommodations use. A more comprehensive set of variables in all three categories would provide a more accurate picture of predictors in accommodations use.

Student Characteristics

Several student characteristic predictors had an effect on accommodations use. Serving a high proportion of students with severe to profound hearing loss had significant odds ratios for accommodations that changed the language of the test, either the directions or the test items themselves. This is not surprising as these students are also more likely to have a variety of communication modes in classroom instruction (Cawthon & the Online Research Lab, 2006). In a related vein, teachers who reported using only speech in instruction were *less* likely to have students who used the test items interpreted accommodation. Additional disabilities also appeared to increase the likelihood of accommodations use. Whether the teacher had students with a learning disability showed consistent effects across accommodations. For ET, TIR, and TII,

teachers with at least one student with a learning disability was more likely to use the accommodation than those who did not, with odds ratios from 1.855 to 2.218. Whether the teacher had students who are both deaf and blind also increased the likelihood that students received ET and TIR. Given the relative paucity of research on SDHH with additional disabilities, these findings broaden the literature base on accommodations use with students who have multiple challenges accessing test content.

Teacher Characteristics

This study focused on two teacher ratings of accommodations: How easy they are to use and the validity of tests taken with the accommodation. McKevitt and Elliott (2003) found that teachers were more likely to use an accommodation if they found it easy to use. Findings from the regression analyses support this finding. For TIR, TDI, and TII, the easier the teacher perceived the accommodation, the more likely at least one of her students was to receive the accommodation. Similarly, ET, TIR, and TII accommodations were used more often by teachers who felt they led to valid test scores. This finding has implications for teacher training and professional development in the areas of assessment accommodations. By focusing on knowledge about validity, professional development programs may shape what accommodations teachers recommend for their students (Shriner & De Stefano, 2003).

Contextual Characteristics

With one exception, district programs with significant odds ratios for interpreting test directions, educational setting did not differentially predict specific accommodations use. This is consistent with previous findings that educational setting plays only a minor role in the prevalence of accommodations use once student characteristics are taken into account (Cawthon & the Online Research Lab, 2006). Teachers in schools for the deaf and district or regional programs serve more students than those with a single SDHH. Yet neither educational setting nor the number of students served by the study participant were significant predictors in this analysis. These findings indicate that school level variables may not be significant factors in whether students receive specific assessment accommodations.

State accommodations policy was the last predictor variable used in this analysis. The regression analyses indicated that state policy played a role only in the most controversial accommodation: test items interpreted. For this accommodation, teachers were more likely to use the accommodation when their state policies either (a) allowed test items interpreted or (b) allowed it in certain circumstances. This shows that there may be some degree of consistency between accommodations policy and practice for test items interpreted. There were no significant odds ratios for the remaining accommodations. However, one issue in these analyses was the amount of missing data for some of the policy variables. Although policy could be included as a predictor variable for extended time, test items read aloud, and test items interpreted, it could not be included as a candidate predictor variable for test directions interpreted due to missing policy data in some states (Clapper et al., 2005).

Conclusion

State standardized assessments are a key component of the NCLB accountability framework. The implications of these results for accountability lie in whether students participate in assessments with accommodations that are tailored to their individual needs. Multi-level analyses of variables predicting accommodations use can be a valuable contribution to what we know about assessment practices with SDHH. Future research may include more variables at the student, teacher, and classroom level. Furthermore, this regression analysis shows that the research focus should shift towards more specificity at the student-level. Additional student characteristics, including individual proficiency language and reading, are important factors to include in future analyses of accommodations use. Through this research program, we hope to help the field develop more precise decision-making criteria for students who are deaf or hard of hearing.

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