A meta-analysis of demographic characteristics and learning by deaf students

Megan Fabich
A Meta-Analysis of Demographic Characteristics and Learning by Deaf Students

MSSE Master’s Project

Submitted to the Faculty of the Master of Science in Secondary Education of Students who are Deaf or Hard of Hearing

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By

Megan Fabich

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Project Advisor, Marc Marschark

MSSE Program Director, Gerry Bateman
Abstract

This study is designed to identify those educational, communication and demographic characteristics which serve as predictors of student performance on college entrance exams as well as their comprehension/learning via interpreted lectures at the college level. A database was created for 509 deaf students using information from 33 different demographic areas. A series of statistical analyses including multiple regressions were performed, none of which yielded statistically significant findings, despite their considerable power. These results indicate that deaf students’ academic success is not pre-determined by any one characteristic or combination of easily identifiable characteristics.

Introduction

Statement of the Problem

In the field of education, many studies have been conducted to determine those qualities most important to students’ success. Educational theories and approaches developed out of these studies have been determined by and designed for hearing students. Very few studies have examined characteristics in deaf or hard-of-hearing students so, while various investigators suggest that deaf and hard-of-hearing students may learn and function similarly to or differently than hearing students in educational settings, we have no reliable indicators as to what characteristics are responsible for indicating and creating higher achievers.

The few studies involving factors that might be related to academic success of deaf and hard-of-hearing students have been limited to small numbers of participants, and thus we usually are unable to isolate any significant predictors of success and academic performance. Having a small “N” presents problems in studying demographics because of the large number of variables being compared in most relevant studies; a larger “N” is needed to be statistically valid (i.e.,
about 10 times the number of predictors) and because of the relative heterogeneity of deaf students (due to individual variance in communication and educational backgrounds). This same constraint of a small “N” has limited the types of statistical analyses that could be performed on sets of data.

The present study was intended to do what previous studies with smaller pools of participants could not. This project was conducted using a collection of institutional and research databases reflecting over 30 different demographic and personal communication characteristics of more than 500 deaf and hard-of-hearing students in an attempt to determine relationships among these characteristics. Sophisticated and comprehensive statistical analyses were conducted. This study also determined which, if any, characteristics were related to students’ performance on their college entrance examinations and their learning through sign language interpreting from university-level lectures.

**Importance of the Problem**

Within the field of deaf education, despite ongoing attempts on the part of parents, educators and researchers, variables that predict student success are still largely unknown. If we are able to determine which variables and conditions provide students with the best possible preparation for success, we would be better equipped to advise parents and advise, prepare and educate students. While some factors are out of parents’ and students’ control, there are certainly enough others which we as educators and professionals in the field have the opportunity to influence, and that opportunity should not be passed by.

This study is of personal importance to me, as a teacher, because I want to have all the knowledge I can about a student’s background and history to identify strengths that I can
capitalize upon, needs that I will have to compensate for or balance, and qualities that are worth taking the time to develop within a student. The only way I will know the best way to focus my time and attention as a teacher is to know what qualities are present in the most successful students. Such knowledge should help me create even more successful students, which is ultimately my goal.

**Objectives**

1. What are the relationships among deaf students' educational, communication and demographic backgrounds and their performance on college entrance examinations?

2. Does the ACT college entrance examinations required by NTID/RIT predict deaf students' performance at the college level?

3. Do specific demographic characteristics predict deaf students' comprehension/learning via interpreted lectures at the college level?

**Literature Review of the Field**

**Student Characteristics, Learning and Achievement**

Various questions within the field of deaf education have been addressed only in situations unlikely to produce convincing or reliable results. Questions dealing with the effect of educational placement, the effect of mother's education on students' performance, and the ability of family background to predict student success are a few such questions. These variables, among many others, have been explored in previous studies with mixed results. Some studies have been unable to identify how a specific factor such as educational placement or mother's education may affect a child, while other studies may identify trends related to certain factors, but be unable to determine if the relationship among these factors is actually causal. This
The body of literature surrounding deaf education contains numerous studies on the effect of mainstreaming deaf and hard of hearing students as compared to educating them in a separate school setting (i.e., schools or programs for the deaf). Kluwin (1993), for example, conducted a study on a rather large but “centralized” group of students (not readily generalized to the greater population), and found that the degree of mainstreaming was likely to have a greater effect on students’ academic achievement than any other program characteristics. Students who were mainstreamed participated in more core academic courses compared to the students remaining in specialized classes for their entire education. Kluwin concluded that the overall effect of mainstreaming is difficult to determine when taken within the context of the curricular track and total educational program.

Several studies have noted that deaf students’ academic abilities vary based on characteristics of the individual students and their placements in differing programs (Karchmer, Milone & Wolk, 1979; Pflaster, 1980, 1981). Gender is one such characteristic that tends to predict placement, with males being placed in mainstream settings more often than females (Holt, 1994; Kluwin, 1993; Stinson & Kluwin, 2003). Possessing better English skills was another characteristic found by Reich, Hambelon, and Houldin (1977) to lead to mainstream placements, while greater hearing losses and additional handicaps tend to reduce mainstream placements (Allen, 1992; Allen & Osborn, 1984; Holt, 1994; Reich et al., 1977; Stinson & Kluwin, 2002).
There is a danger in ignoring other factors that play into the school placement of a student such as family income, which could restrict the access to social and medical services, or the educational level of mothers, which might affect their likelihood to learn and use signed communication and support the child's academic efforts. Family characteristics appear to have less influence on placement decisions. The only family characteristic found to affect placement according to Stinson and Kluwin (2003) was ethnicity, with ethnic minority children being more likely placed in separate school programs. They found no difference in placement related to parents' hearing status or socioeconomic status.

Interestingly, while placement itself has not been found to predict student success, the school itself might make a bigger difference than the type of school. In a study by the U.S. Department of Education, it was found that the "high school curriculum reflects 41 percent of the academic resources students bring to higher education; test scores, 30 percent; and class rank/academic GPA, 29 percent (p. 21)" (Adelman, 1999). From these findings, it would seem that predicting student success is a more complex task than examining the student and their own unique background characteristics, but should also include examining the school and its unique program rigor and curriculum. This would require more data than can be collected by institutions for every student they admit. Test scores and GPA are realistic data worth examining, but neither has exactly the same influence as high school curriculum.

**Predictors of Academic Success**

Beyond student placement, there is the challenge of evaluating a student's academic success. While standardized tests may or may not be ideal indicators of deaf students' academic achievement, they remain the only common indicator available for comparisons across settings (Karchmer & Mitchell, 2003). Other approaches, such as teacher evaluations, local course
grades and receipt of diplomas are too variable and contain too much measurement error to be useful as a predictor across areas for deaf students.

Another area of investigation within the field of educational achievement is the effect of socioeconomic status, typically determined by parents' education; income and occupation have on academic achievement. For deaf students, these issues have not been considered in enough detail to reach any conclusions about the potential these factors might have as indicators of academic achievement, see Karchmer and Mitchell (2003) for a more in-depth description of the problem.

Parents hold the potential to influence their child's development and achievement by the environment in which they raise the child. They have the opportunity to be the most influential source in the educational and developmental life of their deaf or hard-of-hearing child. For decades, families and educators alike have been concerned about the impact of raising a deaf child in a hearing family versus a deaf family. The intrusiveness of overprotective hearing mothers could potentially affect the development of independence and autonomy of the child (Vaccari & Marschark, 1997). If this occurs, there is a likely chance that this effect in development will carry over into the student's academic life and performance as well. Another finding that could bear on deaf students' performance and academic achievement was Dessill's (1994) observation that parent-child communication with deaf teenagers was positively related to self-esteem. Parent-child communication was also positively related to reading levels, further stressing the importance of competent communication in the home.

Understanding that the home of every child is different, some circumstances appear to be more beneficial to deaf students than others. It has been noted in studies by Charrow and Fletcher (1974) and Brasel and Quigley (1977) that deaf students raised in deaf families where
sign language becomes their primary language, taught from birth, function more like hearing children learning a second language and are able to perform better in reading and writing-related tasks. Wilbur (2000) indicated “deaf children of deaf parents are four times more likely to go to college than deaf children with hearing parents” (p. 82).

Standardized test scores are often taken as a measure of a student’s academic abilities. Taking into account deaf students’ performance level on English-related tasks and to accommodate for differences in reading proficiency levels, they are often tested “out of level”. Testing “out of level” means that students are given a test designed for a lower grade. By using a lower level of the test, students can then read the test directions and material, but their scores will not be an accurate reflection of their abilities at their own grade level (Adebi, 2001; Musselman, 2000; see Pitoniak & Royer, 2001 pp. 53-58 for a review of issues related to testing accommodation). Testing these students out of level thus does not produce results that are comparable to their hearing peers. Because these accommodations do not produce an adequate representation of ability, standardized test scores should be interpreted with caution for deaf and hard-of-hearing students.

English language abilities would be expected to have a large impact on standardized test scores, which are administered in printed form. Although there is not a wealth of research surrounding the association of spoken language skills with academic success, speechreading and speech intelligibility have been found to predict standardized test scores of deaf students (Pfaster, 1980, 1981). Without any alternate indicator of these skills, level of hearing loss in the better ear is often the default indicator of speech perception, with profoundly deaf students scoring lower on standardized tests than severely deaf or hard-of-hearing peers, who have more residual hearing (Jensema, 1975; Karchmer, Milone & Wolk, 1979).
**Relationship of Student Characteristics to Learning through Interpreting**

As the percentage of students enrolled in mainstream settings grows, more deaf students are depending on the services of interpreters to receive information in the classroom. In a study by Marschark, Sapere, Convertino, Seewagen, and Maltzen (2004) three experiments were completed to determine how interpreting affects student learning. Lectures were presented through interpreting (ASL) and transliteration (English-based signing) and the results showed no difference in student comprehension on a post-lecture test as a function of either mode of presentation or student communication preference. These findings were consistent regardless of the type of interpreting students self-reported a preference for. Similar findings were obtained by Murphy and Fleischer (1977) and Marschark, Sapere, Convertino, and Seewagen (2005).

The Marschark et al. (2004, 2005) findings also relate to the present study, in that they found that regardless of the form of communication deaf students receive from an interpreter, they learn less than their hearing peers in the same classroom (Jacobs, 1977). The difference between a deaf student's comprehension of nearly 60 percent of material versus a hearing student’s comprehension of over 80 percent of material will potentially make a large difference in their overall learning and academic success (Marschark et al., 2004; Livingston, 1994).

Further, Marschark et al. (2004) showed that deaf students were unable to predict their own level of comprehension. Therefore deaf students cannot anticipate what knowledge might have been lost with the interpreted presentation and utilize resources to ameliorate those losses.

Marschark et al. (2004) noted that lower performance on the comprehension test of the interpreted lecture might be the result of poor academic preparation of deaf students in K-12,
poor K-12 interpreting quality, or the simple fact that the lecture was presented through “mediated instruction” versus direction instruction from the lecturer to the students.

Before undertaking the large and costly studies required to determine the validity of such hypotheses, it seemed worthwhile to take one more look at demographic characteristics and learning, using a much larger sample size than previously available. All of the previously discussed demographics characteristics were examined in the present study, together with information on students’ preferred mode of communication and self-reported communication skills. The procedures described below were intended to provide more conclusive findings than previously and answer the three objectives posed at the outset of this study.

**Method**

**Materials**

This meta-analysis took advantage of data collected since the inception of the National Sign Language Interpreting Project, as part of a project supported by the National Science Foundation. Testing for this project has been approved by the IRB under the following titles: “Access to technical education through sign language interpreting” and “Eliminating communication and technical barriers to STEM education.” The various sources of information currently exist in different formats and locations, and data preparation and coding required significant time and effort prior to analyses. Three primary sources of information were made available for this project. (See Table 1 below)

Data from a total of 509 deaf and hard of hearing students were analyzed. All students had been enrolled at RIT sometime during academic years 2001-2004.
### Demographic Information

Demographic information including data on students' family background, academic history, college entrance test scores, and hearing loss were obtained from extracts of institutional databases created for the National Sign Language Interpreting Project (2001-2004).

### Communication Information

Information concerning students' self-reported communication skills, communication preferences, and related information were drawn from records of the National Sign Language Interpreting Project. That information was collected using a Communication Questionnaire modeled on the Language and Communication Background Questionnaire (LCBQ) (See Appendix A). The LCBQ is completed by most deaf students at RIT when they first enroll. NTID employs the LCBQ rather than face-to-face communication interviews to obtain information on student sign language and spoken language skills because it is more efficient and

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**Table 1**

Demographic Characteristics Analyzed

<table>
<thead>
<tr>
<th>Demographic Information</th>
<th>Entrance Exam Scores</th>
<th>Communication Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>ACT English</td>
<td>Sign to Spoken Language – Pref.</td>
</tr>
<tr>
<td>Entry State</td>
<td>ACT Math</td>
<td>ASL to Signed English – Pref.</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>ACT Natural Science</td>
<td>Age Learned to Sign</td>
</tr>
<tr>
<td>Hearing Aid Use</td>
<td>ACT Composite Score</td>
<td>ASL Production Skills – SR</td>
</tr>
<tr>
<td>Cochlear Implant</td>
<td>Michigan Test</td>
<td>ASL Comprehension Skills – SR</td>
</tr>
<tr>
<td>PTA Left Ear</td>
<td>California Test</td>
<td>Signed English Production Skill – SR</td>
</tr>
<tr>
<td>PTA Right Ear</td>
<td>NTID Reading Placement</td>
<td>Signed English Comp. Skills – SR</td>
</tr>
<tr>
<td>Mother’s Education</td>
<td>NTID Writing Placement</td>
<td>Lecture Pretest</td>
</tr>
<tr>
<td>Father’s Education</td>
<td>NTID Math Placement</td>
<td>Lecture Posttest</td>
</tr>
<tr>
<td>Mother’s Occupation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Father’s Occupation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age of Hearing Loss Onset</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Deaf Parents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Home Language</td>
<td></td>
<td></td>
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<tr>
<td>Type of High School</td>
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</tr>
</tbody>
</table>

Pref. = Preference  
SR = Self-reported
has been found to correlate approximately .80 with interview assessments (Marschark et al., 2004).

Assessments of Content Knowledge and Learning via (Interpreted) Classroom Lectures

Data was assembled from several experiments using similar data-collection methodologies under different test conditions (Marschark et al., 2004, 2005). This information was available for all students who participated in a series of similar experiments. Scores from content-specific pre-tests and post-lecture learning assessments were assembled into a single database.

Procedure

Information necessary for this study was collated and drawn from existing files created in Excel, SPSS, and SAS. A single Excel database was created containing all of the data described above; from that database, SPSS data files were created. In order to test the predictions described earlier, multiple regression and other statistical analyses were applied, as necessary.

The primary procedure used during analyses was a step-wise multiple regression. This form of multivariate analysis allows for many variables to be tested at the same time, to determine which variable(s) impact the assigned dependent variable the most controlling for the effects of others. That is, each of the variables entered into the analysis is held constant in comparison to the other variables so that the variable responsible for the greatest portion of the total variance may be extracted while the regression continues to determine which variable is the next most influential. In using this analysis, all possible combinations among variables are tested to identify any variables that serve as predictors of the dependent variable, which in this case would be the various entrance exam scores and post-test scores of the interpreted lectures.
Missing data were handled using pair-wise deletions in SPSS. A variety of tests of simple main effects also were performed, although results of the multiple regression analysis indicate them to be statistically invalid. Therefore those results will not be discussed.

**Results**

Multiple regressions were performed to determine significant predictors of performance on college entrance exams, performance at the college level, and comprehension/learning via interpreted lectures at the college level. None of these analyses yielded significant predictors. The failure to obtain any significant predictors is not due to a lack of power, as 509 cases were more than sufficient to satisfy the rule of having ten times the number of observations as variables in a multiple regression equation. Rather, these results reflect the fact that prior studies did not have sufficient data available on individual students to avoid confoundings.

**Discussion**

The goals at the outset of this study were to identify educational, communication and demographic predictors of student performance on college entrance exams, to determine the ability of the ACT and other entrance exams to predict student performance at the college level and finally to identify demographic characteristics as predictors of student comprehension/learning via interpreted lectures at the college level. This study has provided results which were previously unable to be obtained.

Due to the large number of student participants available for this study, more appropriate and reliable statistical tests were able to be performed. Employing a multiple regression analysis ensured the most complete analysis possible. The statistical analyses afforded the comparison of a greater number of variables to one another rather than being forced to use analyses that focus
on only one or a limited number of variables. Using such limiting tests ignores other potential variables that could be interconnected, thereby leading to invalid and confounded results.

In light of the present results, researchers should exercise caution when reviewing previous studies and make a clear distinction between those results which possess statistical significance and those which simply show trends in a limited sample study. One such example can be found in the often-cited 1978 study by Trybus and Jensema, *Communication Patterns and Educational Achievement of Hearing Impaired Students*. For decades, many have cited this study as claiming that deaf students with deaf parents have better academic achievement than deaf students with hearing parents. While their study did show a difference in scores, it was not a statistically significant difference. The actual difference in achievement scores between deaf students of hearing parents and those of deaf parents was reported as a difference in mean percentile ranks by age group and even then varied by only a few points. This should not be taken as a conclusive finding that deaf students of deaf parents outperform deaf students of hearing parents, yet that assumption is often cited.

Researchers should also work to correct previously accepted thinking that certain characteristics determine a student’s potential success when this study has shown that it is clearly not the case. Drawing conclusions based on studies with small samples or making generalizations about deaf students based on statistically non-significant data can be damaging to the field of deaf education research and can perpetuate erroneous beliefs. Putting an end to false assumptions about deaf students' personal and family characteristics will allow researchers to address studies with an open mind. It will also allow parents and teachers of deaf students to approach their students with higher expectations and confidence.
The results of this study are encouraging for teachers who now know they have the 
opportunity to influence their students, since academic abilities are not as pre-determined as 
previously thought. Teachers now have greater reason to look beyond the fact that deaf students 
that may or may not have deaf parents, did or did not learn to sign by a certain age, and other 
stereotypes, as we now know that these characteristics do not cause a difference in their 
academics. One beneficial outcome for teachers is the ability to now provide necessary support 
and information to parents emphasizing that their child’s success is not determined or limited by 
certain demographic characteristics that may be out of their control.

Although these outcomes are all of importance to the field of deaf education, for 
researchers and teachers alike, no study is without limitations. It should be kept in mind that the 
participants in this study were all college-level students taken from a limited population. The 
students volunteered to participate in this study and were thereby a self-selected sample. Finally, 
the communication survey used for information regarding language production and 
comprehension scores is a self-report form (see Appendix A).

This study lends itself to more extensive continuations for future studies. Some 
suggestions for further investigations would be to continue expanding the number of variables to 
include more intrinsic factors such as student personality and motivation. It is worth noting that 
while these intrinsic factors may produce additional results, they could also be interrelated to the 
variables tested here and therefore not free of confounds. It may also be worth examining certain 
characteristics of student preparatory programs such as rigor of program, coursework taken, and 
GPA. This information is often difficult to gather for all students, as well as difficult to evaluate 
objectively, and thus was not included in the present study.
This study has shown that none of the educational, communication or demographic characteristics available to NTID were significant predictors of student performance on college entrance exams nor were those characteristics able to predict students comprehension and learning via interpreted lectures at the college level. These results will ultimately provide both researchers and educators with valuable information when planning future studies and educational plans.
References


Appendix A

Communication Questionnaire

1. How much of the interpreter's fingerspelling did you understand?
   All of it   Some of it   None of it

2. How much of the information in the lecture was new to you?
   All of it   Some of it   None of it

3. Please circle all that are true:
   a. I understood the interpreter very well (signs and fingerspelling)
   b. I understood the signs but not the fingerspelling
   c. I did not understand the interpreter
   d. The interpreter signed clearly but I did not understand the lecture

4. The interpreter signed:
   Too fast   Too slow   At a comfortable pace to follow

5. I would understand this material best from (choose ONE):
   a. An interpreter
   b. A teacher signing
   c. Reading about it
   d. Captions
   e. C-Print

6. Overall, how would you rate this interpreter?
   Excellent   Okay   Poor

7. How do you prefer to communicate most of the time? (please circle only one):
a. Sign alone

b. Speech alone

c. Sign and speech together (simultaneous communication)

d. Other ____________________________ (please specify)

8. Please rate your skills in understanding simultaneous communication (speech and sign together). I understand (circle one):

   Everything 5 4 3 2 1 Nothing

9. a. Please rate your skill in producing ASL (circle one):

   Excellent 5 4 3 2 1 No skill

b. Please rate your skill in understanding ASL (circle one):

   Excellent 5 4 3 2 1 No skill

c. Please rate your skill in producing signed English:

   Excellent 5 4 3 2 1 No skill

d. Please rate your skill in understanding signed English (no voice):

   Excellent 5 4 3 2 1 No skill

10. Age you began to learn sign language:

    a. Since birth

    b. _____ years old

    c. Do not know sign language

11. Do you use a hearing aid? Yes ____ No ____

12. Do you use a cochlear implant? Yes ____ No ____

13. Do you use another kind of Assistive Listening Device? Yes ____ No ____

14. Do you use a spoken language other than English with your family?
Yes ____ No ____  If yes, please specify __________________________

*Please circle one number to answer each of the following questions:*

15. **Overall,** I prefer to use

   Sign language   5  4  3  2  1  Spoken language

16. **Overall,** I prefer to use

   ASL    5  4  3  2  1  English-based signing