Chasing the Mythical Ten Percent:

Parental Hearing Status of Deaf and Hard of Hearing Students in the United States[*]

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ABSTRACT

This paper investigates the basis for the frequently reported statement that ten percent of deaf persons are born to families with one or more deaf parents. The prevalence of deaf children born to deaf parents (deaf-of-deaf) is important because it is often cited when describing linguistic and educational advantages, along with social and cultural differences, associated with deaf children born to deaf parents compared to deaf children of hearing parents. This analysis provides a current estimate for the distribution of parental hearing status among deaf and hard of hearing students in United States using data from the Annual Survey of Deaf and Hard of Hearing Children and Youth (1999-2000). This is the first national estimate that fully utilizes the distinction between children having deaf parents and hard of hearing parents, as well as hearing parents. The authors propose that the key demographic to report, other than that the *overwhelming majority* of deaf and hard of hearing students have hearing parents, is whether the child has one or two deaf parents. The Annual Survey findings indicate that *less than five percent* of deaf and hard of hearing students receiving special education are known to have at least one deaf parent, which is less than half of the presumed ten percent. Reasons for the difference between the present and previous estimates are suggested.

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Deaf children born to deaf parents are likely to grow up in a social, cultural, and linguistic milieu different from children of hearing parents (e.g., Erting, 1994; Morford & Mayberry, 2000; Padden & Humphries, 1988; Schein, 1989; Wilcox, 1988). In the United States, deaf children of deaf parents may well have American Sign Language, rather than spoken English (or Spanish, French, Vietnamese, etc.), as their first language of fluency (also see Stuckless & Birch, 1966; Harris, 1978). Whereas severe or profound deafness is not a very common occurrence in the child population, intergenerational deafness is even rarer (e.g., Blanchfield, Dunbar, Feldman, & Gardner, 1999; Niskar et al., 1998; Ries, 1994; Schein & Delk, 1974). In this paper, we address the question of just how prevalent are "deaf-of-deaf" children within the overall group of deaf and hard of hearing children and youth.[1] Our analysis draws into question the often-repeated statement that ten percent of deaf children are born to deaf parents (Schein, 1989).

The prevalence of deaf children of deaf parents has been discussed since the 19th century (see review by Moores, 2001). As far back as the early 1800s, various American schools or agencies have undertaken systematic collection of information about the hearing status of the parents of deaf students (see review by Best, 1943). It was not until the very end of the 19th century, however, that any effort was made to provide an estimate of national prevalence (Fay, 1898). Fay's work influenced the U.S. Census Bureau to include special supplements to collect data on the deafness of family members in 1910

and 1920. Unfortunately, these two early 20th century national estimates were the only ones available until the Annual Survey of Hearing Impaired Children and Youth was initiated in 1968 (hereafter, the Annual Survey; see, for example, Rawlings, 1971, 1973; Jordan & Karchmer, 1986),[2] followed by the National Census of the Deaf Population (NCDP) in 1972 (Schein & Delk, 1974). Soon thereafter, in 1974, a study was conducted by the Office of Demographic Studies (ODS) at Gallaudet College[3] using a sub-sample from "The National Achievement Test Standardization Program for Hearing Impaired Children" (see Jensema & Trybus, 1978; Karchmer, Trybus, & Paquin, 1978; Rawlings & Jensema, 1977), which largely depended on the 1972-73 Annual Survey for its sampling frame. The ODS distributed a special survey to a nationwide random sample of 1,362 students, to which nearly 800 families with deaf or hard of hearing children responded (some with more than one such child), that included a request for parental hearing status information.

The national demographic studies cited above have reported estimates of the proportion of deaf and hard of hearing children with one or more non-hearing parents ranging from three percent (2.2% in 1910 and 3.3% in 1920; Best, 1943) to thirteen percent (Karchmer, Trybus & Paquin, 1978). The variability in these estimates is due to differences in the groups being studied, to methodological differences and, importantly, to differences in terminology. For example, in reporting its findings, the Annual Survey did not routinely make a distinction between being deaf or hard of hearing until 1993, referring to both as "hearing impaired."

For over three decades now, there have been noteworthy efforts to identify the national prevalence of deaf children of deaf parents. However, as mentioned above, we

more often learn how many "hearing impaired" children of "hearing impaired" parents there are. Rawlings (1971, 1973) presented detailed tabulations from two consecutive Annual Surveys of the number of such students whose parents had "hearing loss before age 6" by parental gender. The value of knowing parental gender in either year, important but unmentioned, was to discover that it was far more common to have unavailable data for the father than for the mother. Otherwise, gender identification did not reveal remarkable patterns. The proportion of parents for whom hearing status was reported as "unknown or not reported" in the 1969-70 Annual Survey was greater than in the 1970-71 Annual Survey, but the adjusted prevalence estimates are nearly identical (made evident later in Table 5). Given the strong overlap between the two samples and the superior response rate for the 1970-71 Annual Survey, only the findings from the latter study are reviewed here.

Rawlings (1973, p. 13, Table K) summarized the Annual Survey data by reporting that 89.0% of the students had two hearing parents, 3.1% had one hearing parent and one for whom no information was reported, 4.3% had "one parent with loss," and 3.5% had two hearing impaired parents. However, this summary excluded from analysis nearly half of the students in the Annual Survey due to unreported or unusable student audiological data as well as unavailable parental hearing status data (30% of the students had no available parental hearing status data). Additionally, when one parent was hearing impaired and the other had no available data (a very small group), these students were counted among the 4.3% with one hearing impaired parent rather than in their own separate category. By restoring the students with unavailable audiological data and

consistently categorizing parental hearing status, we would obtain an estimate of 8% for the prevalence of hearing impaired children with hearing impaired parents.[4]

Schein and Delk (1974) reported that 91.7% of the deaf persons in the NCDP came from families where both parents were identified as hearing (based upon a stratified, random sample, household survey of 1,838 persons drawn from the census, from which 1,476 individual responses were collected). However, the remaining 8.3% were not all from families with one or more "hearing impaired" parents. Just over half of these remaining deaf persons counted in the NCDP were from families where complete parental hearing status was "unknown" (this group was 4.3% of the census). Among those for whom both parents' hearing status was known, only 4.2% came from families with one or more hearing impaired parents (0.84% with one hearing impaired parent and one hearing parent, and 3.34% with two hearing impaired parents). The point is that the handling of missing data affected the conclusion. Even if some of the parents with missing data were deaf or hard of hearing, the prevalence would be much less than eight percent. It should be noted that this result is not fully comparable with the findings from the Annual Survey, however, since the population targeted by the NCDP largely included deaf adult respondents.

From the 1974 ODS study, Jensema and co-workers (Jensema & Trybus, 1978; Rawlings & Jensema, 1977) reported the prevalence of hearing impaired children and youth with hearing impaired parents at 8.7%, with 2.7% having two hearing impaired parents and 5.9% with one hearing impaired parent (for those 657 students who had complete achievement and parental hearing status data). Karchmer, Trybus, and Paquin (1978) reported that for the 885 students with complete parental hearing status, regardless

of available achievement data, the prevalence of those with one hearing impaired parent was 10.3%, while for those with two hearing impaired parents, the prevalence remained essentially the same at 2.9%. Though the estimates from the ODS study are variable, and the statistical uncertainty of these low prevalence estimates is not negligible, it is clear that the proportion of deaf and hard of hearing children with two hearing impaired parents is not high. As to the prevalence of those students with one hearing impaired parent, Karchmer and coworkers (1978) did not offer an explanation for their larger value, but did raise a question for which the results of the present study provide the first national estimate: Are "many of the hearing impaired parents of this group of students… hard-of-hearing, as opposed to deaf" (p. 4)?[5]

One additional and relatively more recent study that provides a national prevalence estimate of the parental hearing status of deaf and hard of hearing students does so only incidentally. Using the 1984-85 Annual Survey, Jordan and Karchmer (1986) found that 4% of deaf and hard of hearing children came from families with two "deaf" parents and some additional, but smaller fraction with one deaf parent. (The 1984-85 version of the Annual Survey was the first to ask respondents to distinguish between deaf and hard of hearing parents.) However, this is nearly the entire extent of the discussion, which is found in a footnote with no tabulation of data.

From our review, we conclude that the upper limit on the estimate of the prevalence of deaf-of-deaf students should be less than eight percent. Nonetheless, Schein (1989, p.106) has declared that these national studies, and a few regional studies, fit a "90-percent rule" for the relationship between the hearing status of parents and their offspring. That is, 90% of deaf children are said to have hearing parents and 90% of the

children of deaf parents are hearing.[6] With estimates of the prevalence of deaf children

of deaf parents few and far between, not in perfect accord, all less than ten percent, and

sometimes ambiguously defined, we revisit this claim and assess the accuracy of the "90-

percent rule." Additionally, we highlight the fact that being able to separate students with

hearing impaired parents into two distinct groups, those with deaf parents and those with

hard of hearing parents, is potentially revealing and has important research implications.

This paper utilizes the 1999-2000 Annual Survey of Deaf and Hard of Hearing

Children and Youth to investigate what schools currently know or are able to report about

the parental hearing status of deaf and hard of hearing students in K-12 programs in the

United States, with the intent to provide an estimate of the prevalence of deaf-of-deaf

students at the very end of the 20th century. In the next section, we provide a brief

overview of the Annual Survey, which collects data from more than just K-12 schools

and programs, and a definition of the school-age sample under consideration.

Additionally, we describe in detail how the data for school-age children and youth was

coded and analyzed to generate the results presented in the section thereafter.

METHOD

The Annual Survey, which collects demographic, program, and service data for

each child voluntarily and confidentially provided by schools and programs serving deaf

and hard of hearing pre-K through grade 12 children and youth in the United States, is an

ongoing project of the Gallaudet Research Institute and has been described in detail

elsewhere (e.g., Holden-Pitt & Diaz, 1998; Ries; 1986; Schildroth & Hotto, 1993). Each

year, machine-readable forms are distributed to all public and private schools and

programs that have been identified as providing services for deaf or hard of hearing

children and youth, requesting that one form be completed for each child. Though not all

schools and programs are sure to have been identified, and not all that have been

identified respond, the Annual Survey provides valuable information about deaf and hard

of hearing students and their educational experiences. Ries (1986) has provided a

thorough analysis of the national representativeness of the Annual Survey by comparing

it to other national census and survey activities (i.e., the Annual Report to Congress on

the Implementation of Public Law 94-142, the National Health Interview Survey, and the

National Health and Nutrition Examination Survey). He concluded that,

> it appears that the Annual Survey data offer a good basis for drawing
> conclusions about students receiving special educational services for the
> hearing impaired in the United States. However, conclusions regarding
> profoundly hearing impaired students and students in full-time special
> education for the hearing impaired will have a firmer basis than
> conclusions regarding students with lesser degrees of hearing loss or those
> receiving part-time services. (p. 28)

We must emphasize that the analysis undertaken in this paper pertains to the

frequencies of the various parental hearing status configurations for deaf and hard of

hearing children and youth identified for special educational services. To the extent to

which the parents of this population differ from those of the population of all young

people with hearing impairments, our estimates will require appropriate adjustment.

Unfortunately, there is no data source available to determine whether the estimates

obtained from this analysis are likely to be quite similar to that which would be obtained

from the larger population.

This study focuses on school-age children and youth who are deaf or hard of

hearing. For the purposes of this paper, these young people were 6 to 19 years of age as

of December 31, 1999, as reported in the 1999-2000 Annual Survey. This age group was

7

chosen because it includes students who would be of compulsory or appropriate age for first grade, or at least kindergarten, and would not include those students who remained in school much beyond the upper ages of the school-age population as a whole. This represents the same compromise employed by the Third National Health and Nutrition Survey (Niskar et al., 1998), where the high end for years is between the common low breakpoint of 17 (e.g., the U.S. Census; see Ries, 1986) and the higher cutoff of 21 (e.g., the Individuals with Disabilities Education Act; see U.S. Department of Education, 2000). As a matter of reference, however, we report that the number of students ages 6 to 21 reported to the Annual Survey (42,686) remains about 60% of the aggregated child count reported by the U.S. Department of Education (2000; see also Allen, 1992).

The 1999-2000 Annual Survey includes a request for the hearing status of both the mother and father of the deaf or hard of hearing student. Parental hearing status, which is identified by the school official responsible for transferring data to each student's Annual Survey form, is determined by responses to the following item:

11.   COMMUNICATION
    D. Indicate if the parents of the student are hearing, hard of hearing, or deaf.
Mother: [] Hearing   [] Hard of hearing   [] Deaf   [] Data Not Available
Father: [] Hearing   [] Hard of hearing   [] Deaf   [] Data Not Available.[7]

Of the 11,397 schools that participated in the current survey (1999-2000) or the two previous surveys, 9,555 provided new data or current updates. That is, of the 36,624 school-age children and youth known to the Annual Survey, only 30,970 are included in the current analysis. The 5,654 school-age children and youth excluded from our analysis are primarily those for whom their schools did not respond to the Annual Survey during the 1999-2000 academic year, though there are a small number for whom their

data was not updated despite the fact that their school of record returned updated surveys for other students. (This latter group is missing data for a variety of reasons, which may include lost forms and unrecorded transfers, dropouts, or graduates, for example.)

We do not know how the thousands of schools responding to the Annual Survey identified each student's mother and/or father as being "Hearing," "Hard of hearing," or "Deaf." Federal law (20 U.S.C.S. § 1414(d)(1)(B)(i), 2001) mandates that special education program placement include parent participation in the development of the Individualized Education Program (IEP), so we believe it is safe to assume that at least one parent is known by school personnel.[8] Even when the school does report that the parent is deaf or hard of hearing, however, we still do not know the basis used for deciding between the two possible identifications. This is significant because the results hinge on this distinction. We simply note there is no standard for identifying those who are "legally deaf" similar to statutory definitions for those who are "legally blind."

For the purposes of this analysis, two coding categories for unavailable data responses have been merged into a single category for both the maternal and paternal hearing status variables. Rather than lose students from the sample because of "Missing Data" for a parent's hearing status (i.e., the question was completely unanswered), these blank responses have been recoded as "Data Not Available," thus, retaining all students with current data in the analysis. The maternal and paternal hearing status factors, therefore, have four levels: Hearing, Hard of Hearing, Deaf, and Data Not Available. Though we cannot be certain that school officials intended to communicate the same understanding of the question by responding with Data Not Available instead of simply leaving the question blank (Missing Data), the two responses provide equivalent

9

information for our purposes. Our assumption is that in some instances the data were not

available on parent hearing status because that information had not been deemed

educationally relevant and, therefore, had not been included in the student's records. In

other instances, the information was simply not known by the school official transferring

the data to the survey form. Regardless, we are confronted with cases where there is no

data available for us to specify a particular parent's hearing status.[9]

RESULTS

Table 1 provides a summary of the information about the hearing status of each

student's parents. The first three columns of data are: 1) the number of students whose

mothers are hearing, hard of hearing, deaf, or for whom hearing status is not available, 2)

the percentage of students in each category, and 3) the percentage of students for whom

the mother's hearing status is known. The next three columns give the same data for the

fathers of these same students. There are two key findings. First, for each level of the

Table 1. Parent's Hearing Status by Gender for Each School-Age (6-19) Child or Youth from the 1999-2000 Annual Survey.

Hearing Status	Mother			Father		
	Frequency	Percent	Percent Known	Frequency	Percent	Percent Known
Hearing	26,190	84.57	93.47	24,306	78.48	93.98
Hard of Hearing	721	2.33	2.57	586	1.89	2.27
Deaf	1,109	3.58	3.96	970	3.13	3.75
Data Not Available	2,950	9.53		5,108	16.49	

N = 30,970

maternal and paternal hearing status factors, the percentage of students for whom the

parent's hearing status is known is nearly identical. The proportion of students whose

mothers are known not to be hearing is only slightly greater than the proportion for whom

10

the hearing status of the fathers is known (6.53% vs. 6.02%). Second, the major

difference between the two parents is that we are much more likely to have information

about the hearing status of the mother of each student (90%) than of the father (84%).

What cannot be determined from the available data is whether or not there is a

disproportionate number of deaf or hard of hearing fathers among those for whom we do

not have hearing status information. However, since the percentage of students with

fathers of known hearing status is nearly identical to that of the percentage with mothers

of known hearing status, there is no indication that we should have serious concern for

bias in the knowledge about fathers compared to that about mothers.

Table 2. Parental Hearing Status by Gender for Each School-Age (6-19)
Child or Youth from the 1999-2000 Annual Survey.

Parent		Father				
	Hearing Status	Hearing	Hard of Hearing	Deaf	Data Not Available	Total:
Mother	Hearing	23,569 76.10%	456 1.47%	68 0.22%	2,097 6.77%	26,190 84.57%
	Hard of Hearing	487 1.57%	60 0.19%	40 0.13%	134 0.43%	721 2.33%
	Deaf	118 0.38%	48 0.15%	855 2.76%	88 0.28%	1,109 3.58%
	Data Not Available	132 0.43%	22 0.07%	7 0.02%	2,789 9.01%	2,950 9.53%
	Total:	24,306 78.48%	586 1.89%	970 3.13%	5,108 16.49%	30,970 100.00%

Table 2 presents a cross-tabulation of parental hearing status by gender so that

combinations can be identified. Within each cell, the frequency and percentage of the

11

total sample for each pairing is provided. The rows are the separate levels of the maternal hearing status factor and the columns are the separate levels of the paternal hearing status factor. The levels are arranged so that the diagonal contains the frequencies for students whose parents have the same hearing status. Off-diagonal cells in the table contain the number of students whose parents do not have the same hearing status. The second to last row and column contain the counts for students whose schools did not report any available hearing status information on one or both parents. The last row and column verify the totals provided in Table 1.

In order to assist in the interpretation of Table 2, two figures are provided. Figure 1 reproduces the frequency data in Table 2 in the form of a clustered bar graph. This depiction should be interpreted from the perspective of knowledge of the hearing status of each child's mother broken down by the father's hearing status. (Note the scale break for the bar representing the 23,569 students for whom both parents are hearing.) Additionally, Figure 1 presents the within group percentages on each bar. That is, for a given level of mother's hearing status, the percentages indicate the proportion of mothers with that particular hearing status for whom the father had a particular hearing status. For example, the first and tallest column in the first cluster, the one with the scale break, notes that 89.99% of students with hearing mothers also had hearing fathers; the first column of the second cluster notes that 67.55% of students with hard of hearing mothers also had hearing fathers (487 students); the third column of the third cluster notes that 77.10% of students with deaf mothers also had deaf fathers (855 students); the fourth column of the fourth cluster notes that 94.54% of students whose mother's hearing status was not provided also did not have their father's hearing status recorded (2,789 students).

12

Figure 2 reproduces the frequency data in Table 2 in the form of a clustered bar graph as well, but this time the interpretation is from the perspective of knowledge of the hearing status of each child's father, broken down by the mother's hearing status. (Note the same scale break for the bar representing the 23,569 students for whom both parents are hearing.)

Figure 1. Mother's Hearing Status by Father's Hearing Status for School-Age (6-19) Children and Youth from the 1999-2000 Annual Survey.
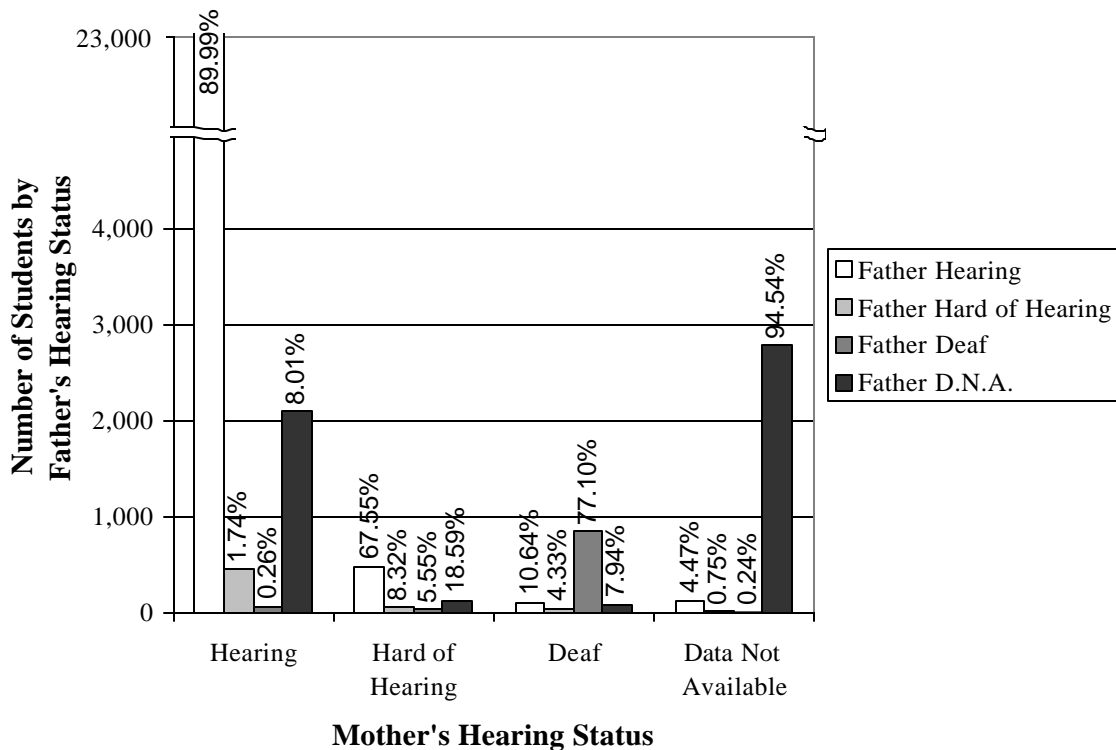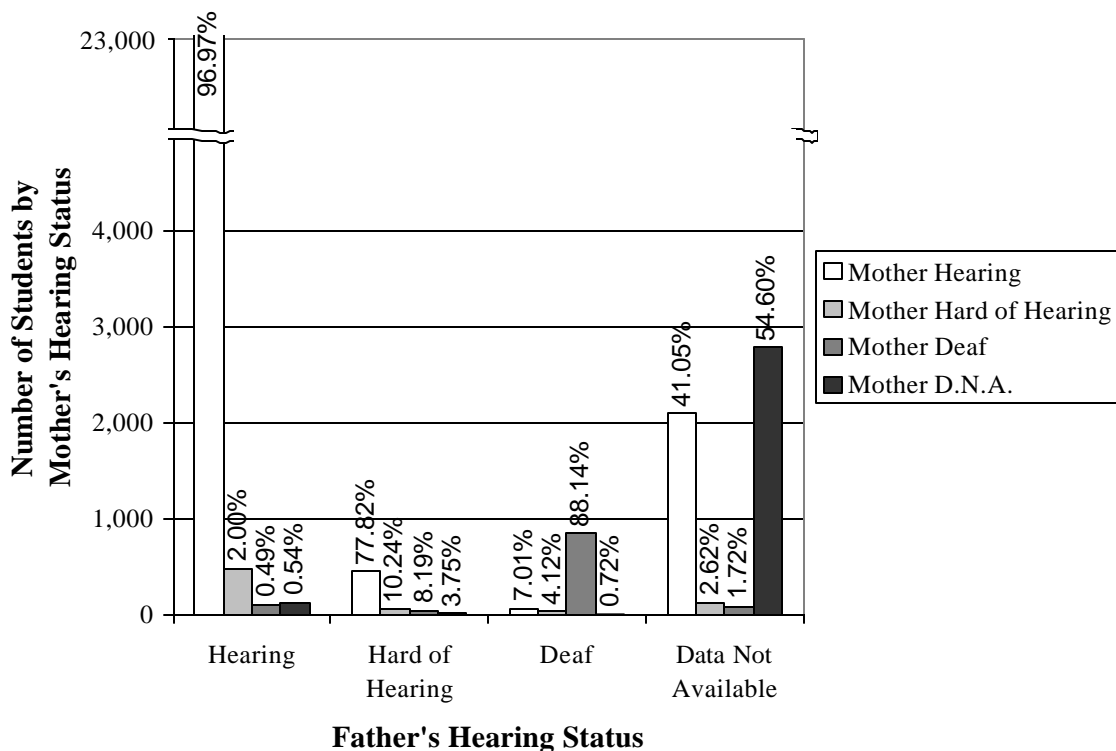
Figure 2. Father's Hearing Status by Mother's Hearing Status for School-Age (6-19) Children and Youth from the 1999-2000 Annual Survey.

Organizing the parental hearing status data as in Table 2 provides substantial detail. First, even when leaving missing data in the analysis, the overwhelming majority of deaf and hard of hearing school-age children and youth in the Annual Survey come from families where both parents are known to be hearing (76.10% of the 30,970). In combination with the other parental hearing status categories, fully 87% of the students are known to have at least one parent who is hearing. Further, if we assume that the distribution of parental hearing status among those with no available data is similar to that of those for whom data is known – a reasonable assumption here – then most of the 9.01% of students with both parents having no available data have at least one hearing

parent. That is, the number with at least one hearing parent could exceed 95% (also see

Table 3 below).

Second, as would be expected from Table 1, we find far more students for whom

the mother's hearing status is known but the father's is not than the other way around.

This informational difference is significant because the magnitude of the difference

between what we know about the mother's hearing status, when compared to the father's

hearing status, can be profound. When the school reports no data on the mother's hearing

status, there is almost always no data on the father's hearing status (94.54% – the fourth

bar of the fourth cluster in Figure 1). But when there is no data on the father's hearing

status, a very large proportion of the mothers are hearing (41.05% – the first bar of the

fourth cluster in Figure 2). For maternal hearing status, we are more than twice as likely

to have no data available on the hearing status of the student's father if the mother is hard

of hearing (19% of the row total compared to 8% of the row totals for hearing and deaf

mothers). This comparison can be found by noting the values on the fourth column of

each cluster in Figure 1. The pattern of having less data available is similar for the

students with hard of hearing fathers, but the numbers are much smaller (<4% of the

column total compared to <1% of the column totals for hearing and deaf fathers). This is

noted on the fourth column of each cluster in Figure 2.

Third, ignoring parental gender distinctions, students with at least one hard of

hearing parent also are very likely to have one hearing parent (76%). The tallest bar in

the second cluster for both Figures 1 and 2, by far, is the first – a hard of hearing parent

paired with a hearing parent. Only about 12% of the students known to have a hard of

hearing parent have a second parent who is known to be deaf or hard of hearing. And as

noted above, there is more difficulty obtaining the hearing status of the second parent for students who have at least one hard of hearing parent, with the father's hearing status much more likely to be unavailable.

Fourth, also ignoring parental gender identification, students with at least one deaf parent are very likely to have two deaf parents (70%). That is why the tallest bar in the third cluster for both Figures 1 and 2 is the third. Only about 15% of the students known to have a deaf parent are also known to have a hearing parent (the much smaller, yet second tallest bar in the third cluster of both Figures 1 and 2). Again, as noted earlier, the unavailability of hearing status information concerning the second parent for students who have at least one deaf parent is about the same as that for students who have at least one hearing parent, with the father's hearing status more likely to be unavailable.

Finally, the parents of deaf and hard of hearing school-age children and youth are very likely to be paired deaf with deaf and hearing with hearing or hard of hearing. The dominant parental hearing status configurations, other than both parents being hearing (setting aside when both parents have no available data), are a) one hearing parent and one parent with no available data, b) one hearing and one who is hard of hearing, and c) both parents being deaf. The number of students for whom both parents are deaf is 1.5 times the total of all remaining parental hearing status pairings.

DISCUSSION

Based upon the foregoing examination, there are three ways to greatly simplify the analysis of students' parental hearing status. First, we can ignore parental gender distinctions. Information about parental gender primarily helps us to recognize that the fathers' hearing status is harder to know, but this does not appear to bias our overall

16

understanding of the family hearing status demographics presented. Second, we can exclude students with unavailable parental hearing status data, which causes us to lose a number of students from the analysis; but again, there does not appear to be undue bias introduced. Finally, we can aggregate parental hearing status combinations to a reduced set of pairings. The small numbers for all but four types of pairings of the parental hearing status factors, for which at least one parent's hearing status is known, suggest that further aggregation may be considered for summarizing the available information for each student. Far fewer than the ten possible gender-free combinations account for virtually all of the data.

Our final representations of parental hearing status data come in two forms. We reduce complexity by aggregating the parental hearing status combinations to two alternative three-level factors. Our motivation for these concise representations has two sources. First, in addition to the fact that there are a limited number of frequently occurring parental hearing status combinations, as noted above, we must aggregate for the purpose of comparison with prior research. Our level of detail is greater than any other presentation in the literature. Second, the work of the 1970s has left us with an ambiguous legacy. There were no distinctions made between deaf and hard of hearing parents. As such, we draw on other findings reported by Jensema and Trybus (1978). Namely, when a deaf or hard of hearing child has two "hearing impaired" parents, use of sign language communication is quite common, particularly at home. This is consistent with the idea that many deaf-of-deaf children are raised in a signing environment. Additionally, our results indicate that if a student has one deaf parent s/he is very likely to have two deaf parents. However, when there is only one "hearing impaired" parent, use

17

of speech is more common than it is among families including a deaf child in which both parents are hearing (Jensema & Trybus, 1978). Since our results show that the student who has only one hearing impaired parent is far more likely to have that parent identified as hard of hearing than as deaf, the distinction among kinds of hearing impaired parents may turn out to be quite important.

There is a serious error of which we may be guilty without attending to the distinction between deaf and hard of hearing parents: we may overestimate the prevalence of deaf-of-deaf students. As such, the two alternatives presented here take advantage of having explicit identification of parents as hearing, hard of hearing, or deaf, as opposed to only hearing or hearing impaired, by examining what happens to prevalence estimates when hard of hearing parents are considered separately as either equivalent to hearing parents or to deaf parents. That is, we explore the possibility that when a parent has been identified as hard of hearing, this is an indicator of being oriented toward the use of sound and speech, whereas if a parent has been identified as deaf then the indication is that s/he is oriented toward the use of a signed language.

Given that hard of hearing parents are more likely to be married to or otherwise paired with hearing parents than either hard of hearing or deaf parents, we first explore the patterns apparent when looking at the distinction between parents described simply as being deaf or not. Students with hearing and hard of hearing parents are counted together, separately from those with deaf parents. Table 3 presents the revised set of frequencies and percentages for this representation. All students for whom any parent has unavailable hearing status data have been dropped. That is, in addition to the 2,789 students for whom neither parent has available hearing status data, we have dropped the

18

2,480 students for whom only one parent has no available hearing status data. In this case, our estimate of the proportion of deaf-of-deaf students in the United States is 4.4% (1.07% with one deaf parent and 3.33% with two deaf parents). In other words, roughly 96% of deaf and hard of hearing children have no deaf parents.

Table 3. Parental Hearing Status as a Function of the Number of Deaf Parents for Each School-Age (6-19) Child or Youth from the 1999-2000 Annual Survey.

Parents' Hearing Status		Frequency	Percent
No deaf parents		24,572	95.61
One deaf parent		274	1.07
Two deaf parents		855	3.33
	Total:	25,701	100.00

Following a different analytical path, we can ignore the apparently strong preference for hard of hearing parents to marry or pair with hearing parents, and consider deaf and hard of hearing as equivalent. This reproduces the hearing impaired category of the 1970s. Table 4 provides a revised set of frequencies and percentages based upon the assumption that there should be no distinction between deaf and hard of hearing parents and that the key distinction is between being hearing or not. The prevalence of deaf and hard of hearing (hearing impaired) students born to one or more hearing impaired parents is estimated by assuming that we should count the children for whom schools identify one or more of their parents as hard of hearing as well as those for whom the parents were identified as deaf. We can see that close to 92% of deaf and hard of hearing children have only hearing parents, more than 4% have only one deaf or hard of hearing parent (of whom 84% have one hard of hearing parent), while slightly less than 4% have two deaf or hard of hearing parents (of whom 85% have two deaf parents).

Table 4. Parental Hearing Status as a Function of the Number of Hearing Impaired Parents for Each School-Age (6-19) Child or Youth from the 1999-2000 Annual Survey.

Parents' Hearing Status	Frequency	Percent
No hearing impaired parents	23,569	91.70
One hearing impaired parent	1,129	4.39
Two hearing impaired parents	1,003	3.90
Total:	25,701	100.00

Note: Hearing impaired is purposely used to coincide with the terminology of the 1970s; the term includes both deaf and hard of hearing parents.

Table 5 presents the percentages in Table 4 so that they may be directly compared with previously cited studies. The average (mean) values across the estimates from the current study and the five other studies reviewed are provided in the last row of Table 5.

Table 5. Revised Prevalence Reports from Studies of the Parental Hearing Status of Deaf Persons from the 1970s to the Present.

	Percent with Complete Parental Hearing Status Information		
Study	Both Hearing	One Hearing & One Deaf or Hard of Hearing	Both Deaf or Hard of Hearing
Present Study	91.70	4.39	3.90
Jensema & Trybus (1978)	91.32	5.94	2.74
Karchmer, Trybus, & Paquin (1978)	86.77	10.28	2.94
Schein & Delk (1974)	95.82	0.84	3.34
Rawlings (1973)	92.67	3.53	3.79
Rawlings (1971)	91.93	3.95	4.12
Mean	91.70	4.82	3.47

Note: If one or more parents have unknown hearing status, the individual was excluded.

The percentages from previous studies found in Table 5 do not precisely reproduce tables from the earlier works, however. Recalculation of percentages from frequency data

reported by Rawlings (1971, 1973) was necessary to provide results comparable to the current presentation. Also, keep in mind that the previously discussed calculations based on the work of Schein and Delk (1974) actually reference a different population.

Review of the first column of Table 5, which presents the various studies' findings of the percentage of persons from families where both parents have been identified as hearing, suggests that 92% is probably an accurate figure for the prevalence of deaf and hard of hearing children born to hearing parents. Eight percent is the complementary estimate for the proportion of deaf and hard of hearing students with one or more hearing impaired parents.

The percentages reported in the second and third columns of Table 5 are less consistent than those in the first column. Our findings are relatively consistent with those of Rawlings (1971, 1973). The remaining eight percent are roughly evenly split, having about somewhat more than four percent of the students with only one hearing impaired parent and a little less than four percent with two hearing impaired parents. This pattern is also consistent with the average values across the six studies, though the split is a little closer to five percent with one hearing impaired parent and three percent with two hearing impaired parents when looking at the average values. The NCDP (Schein & Delk, 1974) and ODS (Jensema & Trybus, 1978; Karchmer, Trybus, & Paquin, 1978) studies have more extreme values by comparison. One reason for the larger difference with the Schein and Delk (1974) estimates may be the different population identified, though our experience with the difficulty of identifying the second parent for children with a hard of hearing parent suggests that such persons may have been undercounted by the exclusion rule invoked by these authors. Another reason for large differences is the

level of uncertainty of both the NCDP (N=1,476) and ODS estimates (N=885 [or 657]). That is, sampling and methodological variability may be responsible for the larger fluctuations in the prevalence estimates for these much smaller groups.

Before proceeding to evaluate the significance of the findings reported here, we should point out that it is true that nine percent of the students in this school-age sample have no parental hearing status available. The number of students for whom both parents have unknown hearing status is more than twice the number with at least one known deaf parent and seventeen percent greater than the number with at least one deaf or hard of hearing parent. If it were not for the consistent pattern of unavailable versus available data for each parent, and that the only bias appears to be underreporting of the father's hearing status, the estimates for the population of school-age deaf and hard of hearing children and youth with one or more deaf parents and for one or more deaf or hard of hearing parents would be seriously compromised. As such, we emphasize that the number of students with one or more deaf parents is small and represents a small but important proportion of the total number of deaf and hard of hearing children in the Annual Survey. The number of students with one or more deaf or hard of hearing parents is larger, but still rather small compared to those children and youth who are known to have only hearing parents.

CONCLUSION

There are two major findings to emphasize here. First, making an estimate of the prevalence of deaf-of-deaf students in the current generation of school-age children and youth is a difficult matter. As we discussed in the Methods section, our sample is limited to generalizing only about those students identified for education services in relationship

to their deafness and not all possible deaf and hard of hearing children and youth in the United States. Additionally, there are a large number of students for whom no parental hearing status information is available. The schools seem to have particular difficulty reporting the father's hearing status. Fortunately, there do not appear to be any systematic biases in reporting that would cause us to believe that students for whom no paternal hearing status data have been provided come from families with a notably different distribution of parental hearing status.

Second, our analysis strongly suggests that Schein's (1989) "90 percent rule" is not entirely accurate. To expect that 10% of the deaf and hard of hearing children and youth in the United States, at least those identified for educational programs or services in relation to their deafness, come from families with at least one deaf parent would certainly overshoot the mark. Four percent is a safer estimate, with roughly three-quarters of these children coming from families where both parents are deaf. Our reinterpretation of the Schein and Delk (1974) data, which provided the estimate of 4.2% of deaf adults were born to hearing impaired parents cited in the introduction to this paper, offers a figure that is nearly identical to our current estimate of 4.4% of deaf and hard of hearing children and youth come from families with deaf parents (not both deaf and hard of hearing). However, if we include students for whom at least one parent is hard of hearing when estimating the prevalence of deaf-of-deaf students we come closer to, but still short of, 10%. Our estimate that 8.3% of deaf and hard of hearing students come from families with deaf or hard of hearing (hearing impaired) parents is not precisely on target. The current estimate is consistent with most of the previously cited estimates (see Table 5). Regardless, based upon the average across all national estimates

published since 1970, rounding up to 10.0% would introduce about a *25% error* in estimating the prevalence of deaf and hard of hearing children born to deaf or hard of hearing parents. Ninety-two percent of the children are from families where both parents are hearing (8% from families with deaf or hard of hearing parents).[10] Nearly 96% of the children are from families with no deaf parents (4% from families with deaf parents).

Our second finding begs for research that would identify meaningful distinctions between being a deaf or hard of hearing child of a family with at least one identified deaf parent and being of a family with at least one identified hard of hearing parent. Particularly when examining the individual and collective life course differences associated with the culturally and linguistically unique status of the American-Sign-Language-fluent deaf-of-deaf population, a national-origin language minority group,[11] identifying the indicators for who counts among this group is essential. If our assertion that only the students identified as having at least one deaf parent defines the correct indicator for identifying the deaf-of-deaf population, then the "90 percent rule" would cause us to overestimate by more than double the prevalence of students with deaf parents.

NOTES

1. For brevity's sake, we employ this well-known descriptive phrase (for examples of use, see Ramsey, 1997; Roots, 1999). In the context of this study, reference to deaf children should be taken to include all deaf and hard of hearing children receiving educational services in relation to their deafness.

2. The Annual Survey collected parental hearing status information in its first two full survey years (1969-70 and 1970-1971), during the mid-1980s (1984-85 through 1986-87), and has done so continuously since the 1995-96 survey.

3. Subsumed under the Gallaudet Research Institute, which continues to conduct the renamed (beginning with the 1993-94) Annual Survey of Deaf and Hard of Hearing Children and Youth, at what is now Gallaudet University.

4. Each student's parental hearing, both for those with and those without available audiological data, was provided in Table 9 of Rawlings (1973, p. 22). By consistent, we mean that 8% of the sample of students with available parental hearing status data for both parents has one or more hearing impaired parents. Students for whom one or more parents had no available parental hearing status data were not included in the estimate.

5. This question was motivated by examining the results of the contracted Texas State Survey of Hearing Impaired Children and Youth (Karchmer, Rawlings, Trybus, Wolk, & Milone, 1979), which asked if the students had "deaf" parents rather than "hearing impaired" parents. This study found that only 2.51% of the students had one deaf parent and that 2.14% had two deaf parents (95.36% had two parents were not deaf). From the year-later and smaller Louisiana State Survey of Hearing Impaired and Deaf-Blind Children and Youth (Karchmer & Wolk, 1980), estimates for both the prevalence of

25

students from families with one or two hearing impaired parents and from families with one or two deaf parents can be extracted since, as in the current Annual Survey, respondents were asked to identify each student's mother and father as hearing, hard of hearing, or deaf. In Louisiana (1978-79), the percentage of hearing impaired and deaf-blind children and youth for whom both parents were hearing was 92.77%, which would increase to 95.87% when hard of hearing parents are included as hearing. The percentage of students with one hearing impaired (deaf or hard of hearing) parent was 4.39%, which decreased to 1.81% when asking how many had one deaf parent. The percentage of students for whom both parents were hearing impaired was 2.84%, which decreased only slightly to 2.32% when asking how many had two deaf parents.

6. Schein (1989, pp. 131-132) offers in a footnote that "the 90-percent figure is likely to be an underestimate" of the proportion of deaf children with hearing parents, but does not qualify this anywhere else, nor does he speculate as to just how far he underestimates the proportion of deaf children with hearing parents by setting the figure at 90%.

7. This question assumes that parental hearing status is directly relevant to the mode of communication chosen in the home. The critical implication of this assumption is that a deaf or hard of hearing child with deaf parents has been exposed to sign language since birth. We are aware of small studies by Stuckless and Birch (1966) and Harris (1978), which identify the extent to which we would be wrong in this assumption. Stuckless and Birch, having a sample of 71 deaf-of-deaf children and 243 deaf-of-hearing children, found that though slightly more than a third of the deaf-of-deaf children's parents reported they did not sign with their "baby," only seven percent responded that they did not sign with their deaf "child." Similarly, Harris, having a sample of 50 deaf-of-deaf

children and 274 deaf-of-hearing children, found that about a quarter of the deaf-of-deaf children's parents reported they did not sign with their child before they learned s/he was deaf, while less than ten percent responded that they did not sign or fingerspell with their deaf child.

8. Some deaf and hard of hearing students have deaf siblings. There is no variable indicating whether or not there are other school-age siblings in the 1999-2000 Annual Survey. As such, the data provided may overestimate the number of parents about whom information has been recorded for each student. This is not a problem, however, since the quantity of interest is the fraction of deaf and hard of hearing children from families with deaf parents, not the proportion of parents who are deaf.

9. There are potential biases introduced by collapsing all unavailable parental hearing status data into the category of Data Not Available. Analysis of the distribution of Data Not Available and Missing Data responses indicates the need for discussion of two issues related to data collection for the Annual Survey (data available upon request). First, there are a modest number of cases where centralized reporting sources (i.e., state, county, or district personnel rather than individual school site personnel) fill out or update student surveys. When educators not at the student's school site are responsible then not all information deemed educationally relevant for each student, such as her/his parents' hearing status, may be available to the person transferring data to the survey form. Missing or unavailable data is then an artifact of the survey management strategy for these instances (e.g., district personnel reporting on students served by itinerant teachers or state schools for the deaf reporting on students served in mainstream programs by state personnel).

The second issue relevant to the prevalence of Data Not Available and Missing Data responses is that the reporting volume influences the consistency and completeness of response choice. In general, the preferred response type is Data Not Available (2.6 times more likely for the mother and 4.0 times more likely for the father). However, when school sites serve more students, either form of unavailable data response is more likely (i.e., both Missing data and Data Not Available responses are likely to be recorded at sites with a larger program and, in very rare cases, for the same student at these sites). In particular, the schools with very large numbers of deaf and hard of hearing students (100 or more) are most likely to leave parental hearing status blank, creating a bias in the type of unavailable data recorded for special schools or centers. There is no indication that this bias is anything other than a paperwork management problem.

10. Without attribution to any primary research study, Schein (1989, p. 107) also states that 92% of the "deaf population" have "two normally hearing parents." In keeping with our summary in Table 5, Schein states that 3.5% have one "hearing-impaired" parent and 4.5% have two "hearing-impaired" parents. Our findings are in substantial agreement with these statements and not the "90-percent rule."

11. This perspective was articulated by The National Center for Law and the Deaf at Gallaudet College in the mid- to late-1970s (see Woodward, 1978) and was adopted by The Commission on Education of the Deaf (1988) as well.

REFERENCES

Allen, T. E. (1992). Subgroup differences in educational placement for deaf and hard of hearing students. *American Annals of the Deaf, 137*(5), 381-388.

Best, H. (1943). *Deafness and the deaf in the United States.* New York: Macmillan.

Blanchfield, B. B., Dunbar, J., Feldman, J. J., & Gardner, E. N. (1999, August). *The severely to profoundly hearing impaired population in the United States: Prevalence and demographics.* Bethesda, MD: Project HOPE Center for Health Affairs.

Erting, C. (1994). *Deafness, communication, social identity: Ethnography in a preschool for deaf children.* Burtonsville, MD: Linstok Press.

Fay, E. (1898). *Marriages of the deaf in America.* Washington, DC: Gibson Brothers.

Harris, R. I. (1978). The relationship of impulse control to parent hearing status, manual communication, and academic achievement in deaf children. *American Annals of the Deaf, 123*(1), 52-67.

Holden-Pitt, L., & Diaz, J. A. (1998). Thirty years of the Annual Survey of Deaf and Hard-of-Hearing Children and Youth: A glance over the decades. *American Annals of the Deaf, 143*(2), 72-76.

Jensema, C. J., Trybus, R. J. (1978, August). *Communicative patterns and educational achievement of hearing impaired students* (Series T, Number 2). Washington, DC: Gallaudet College, Office of Demographic Studies.

Jordan, I. K., & Karchmer, M. A. (1986). Patterns of sign use among hearing impaired students. In A. N. Schildroth & M. A. Karchmer (Eds.), *Deaf children in America* (pp.125-138). San Diego, CA: College-Hill Press.

Karchmer, M. A., Rawlings, B. W., Trybus, R. J., Wolk, S. & Milone, M. N. (1979,

  September). *Educationally significant characteristics of hearing impaired*

  students in Texas, 1977-78 (Series C, Number 4). Washington, DC: Gallaudet

  College, Office of Demographic Studies.

Karchmer, M. A., Trybus, R. J., & Paquin, M. M. (1978). *Early manual communication,*

  parental hearing status, and the academic achievement of deaf students. Paper

  presented at the annual meeting of the American Educational Research

  Association, Toronto, Ontario, Canada.

Karchmer, M. A., & Wolk, S. (1980, September). *Louisiana state survey of hearing*

  impaired and deaf-blind children and youth, 1978-79 (Series C, Number 5).

  Washington, DC: Gallaudet College, Office of Demographic Studies.

Moores, D. F. (2001). *Educating the deaf: Psychology, principles, and practices* (5th ed.).

  Boston: Houghton Mifflin Company.

Morford, J. P., & Mayberry, R. I. (2000). A reexamination of "early exposure" and its

  implications for language acquisition by eye. In C. Chamberlain, J. P. Morford,

  and R. I. Mayberry (Eds.), *Language acquisition by eye* (pp. 111-127). Mahwah,

  NJ: Lawrence Erlbaum Associates, Publishers.

Niskar, A. S., Kieszak, S. M., Holmes, A., Esteban, E., Rubin, C., & Brody, D. J. (1998).

  Prevalence of hearing loss among children 6 to 19 years of age: The Third

  National Health and Nutrition Examination Survey. *Journal of the American*

  Medical Association, 279(14), 1071-1075.

Padden, C., & Humphries, T. (1988). *Deaf in America: Voices from a culture.*

  Cambridge, MA: Harvard University Press.

Ramsey, C. L. (1997). *Deaf children in public schools: Placement, context, and consequences.* Washington, DC: Gallaudet University Press.

Rawlings, B. (1971, June). *Summary of selected characteristics of hearing impaired students – United States: 1969-70* (Series D, Number 5). Washington, DC: Gallaudet College, Office of Demographic Studies.

———. (1973, March). *Characteristics of hearing impaired students by hearing status – United States: 1970-71* (Series D, Number 10). Washington, DC: Gallaudet College, Office of Demographic Studies.

Rawlings, B. W., & Jensema, C. J. (1977, August). *Two studies of the families of hearing impaired children* (Series R, Number 5). Washington, DC: Gallaudet College, Office of Demographic Studies.

Ries, P. (1986). Characteristics of hearing impaired youth in the general population and of students in special educational programs for the hearing impaired. In A. N. Schildroth & M. A. Karchmer (Eds.), *Deaf children in America* (pp.1-31). San Diego, CA: College-Hill Press.

———. (1994, March). *Prevalence and characteristics of persons with hearing trouble: United States, 1990-91* (Vital and Health Statistics, Series 10: Data from the National Health Survey, No. 188). Hyattsville, MD: U.S. Department of Health and Human Services, Public Health Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

Roots, J. (1999). *The politics of visual language: Deafness, language choice, and political socialization.* Ontario, Canada: Carleton University Press.

Schein, J. D. (1989). *At home among strangers.* Washington, DC: Gallaudet University
Press.

Schein, J. D., & Delk, M. T., Jr. (1974). *The deaf population of the United States.* Silver
Spring, MD: National Association of the Deaf.

Schildroth, A. N., & Hotto, S. A. (1993). Annual Survey of Hearing-Impaired Children
and Youth: 1991-92 school year. *American Annals of the Deaf, 138*(2), 163-171.

Stuckless, E. R., & Birch, J. W. (1966). The influence of early manual communication on
the linguistic development of deaf children. *American Annals of the Deaf, 111*,
452-460, 499-504.

The Commission on Education of the Deaf. (1988, February). *Toward equality:*
Education of the deaf. Washington, DC: U.S. Government Printing Office.

U.S. Department of Education. (2000). *Twenty-second annual report to Congress on the*
implementation of the Individuals with Disabilities Education Act. Washington,
DC: Author.

Wilcox, S. (Ed.). (1988). *American deaf culture: An anthology.* Silver Spring, MD:
Linstok Press.

Woodward, J. (1978). Some sociolinguistic problems in the implementation of bilingual
education for deaf students. In F. Caccamise & D. Hicks (Eds.), *American Sign*
Language in a bilingual, bicultural context: Proceedings of the Second National
Symposium on Sign Language Research and Teaching (pp. 183-209). Silver
Spring, MD: National Association of the Deaf.