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Interpreter competencies in science, technology, engineering, and mathematics as identified by deaf professionals

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Interpreter Competencies in Science, Technology, Engineering, and Mathematics as Identified by Deaf Professionals

By

Christopher Grooms

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ABSTRACT

Interpreter Competencies in Science, Technology, Engineering and Mathematics as Identified by Deaf Professionals

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Since the 1990's there has been an ever increasing number of Deaf people seeking higher education and pursuing a wide variety of professions and careers that enhance their life experiences. The Science, Technology, Engineering, and Mathematics (STEM) fields have seen an influx of Deaf people interested in engaging in education and life-long careers in these fields and their respective disciplines. One of the reasons behind this growing interest by Deaf people is the National Science Foundation's commitment to expanding the participation of underrepresented groups in STEM (NSF, 2012). Many Deaf students in higher education and Deaf professionals engaging in STEM careers and professions report a lack of qualified signed language interpreters available to access communication events that are necessary to become successful in these fields and disciplines.

In the field of signed language interpreting worldwide there has been no research conducted on interpreters and the interpreting process in STEM. There abound many anecdotal experiences by Deaf professionals and signed language interpreters alike regarding the challenges of working and interpreting in STEM. One consequence of not having qualified signed language interpreters in STEM is that the professional development of Deaf students and Deaf professionals who choose to study and build careers in these fields is hampered. In this exploratory study, competencies specific to interpreting in various aspects of the STEM fields and disciplines, as identified by the Deaf consumers who engage interpreting services, will be identified and described.

INTRODUCTION

Background

Since the implementation of the Americans with Disabilities Act (ADA) in 1990, there has been a steady increase of Deaf people seeking higher education and pursuing professions and careers that enhance their life experiences. One area where there has been an increase in interest by Deaf people is in the Science, Technology, Engineering, and Mathematics (STEM) fields. The National Center for Science and Engineering Statistics (NCSES) reported that in 2010, 237 Deaf people earned doctorate degrees in diverse fields; 40% of the doctorates earned were in the STEM disciplines (NCSES, 2011a). One of the reasons behind this is the National Science Foundation's (NSF) commitment to expanding the participation of underrepresented groups in STEM (NSF, 2012).

Many interpreters who work between signed and spoken languages may shy away from interpreting in the STEM fields possibly due to the degree of difficulty and lack of familiarity with the subject matter. There is also a lack of consistency in standard sign vocabulary for STEM terms which makes it challenging for interpreters to keep track of what is acceptable for specific clients and what is commonly used in specific settings. There is a movement to consolidate and standardize STEM sign vocabulary led by Deaf professionals in the STEM fields through the Science Signs Lexicon project (Rochester Institute of Technology, n.d.) housed at the National Technical Institute for the Deaf (NTID), which is a subsidiary of the Rochester Institute of Technology (RIT), and the ASL-STEM Forum (University of Washington, n.d.) which is led by the University of Washington in partnership with NTID and Gallaudet University. There are several other resources available; however, there is no coordinated effort to consolidate these

resources and standardize signs (Ladner, Lange, & Kushalnagar, 2012). While these resources are useful for both interpreters and Deaf people alike, they are far from being comprehensive and many interpreters are unaware that these projects even exist and can be accessed through the internet.

In addition to the difficulty of the subject matter and lack of standardized STEM sign vocabulary; there are very few opportunities for interpreters to engage in training related to providing services in the STEM disciplines. Those trainings and workshops that do exist tend to be half to full day workshops offered by individuals, both Deaf professionals and signed language interpreters, who have developed expertise in specific STEM disciplines. While useful to both student and professional interpreters, these trainings and workshops do not offer the in depth education and skill development necessary to prepare one for a career focus on providing interpreting services in the STEM fields. Interpreter preparation programs across the U.S. focus on training interpreters to enter the field of interpreting as generalists. One program offers specialized training/coarse work to prepare interpreters for providing services specific to one setting. St. Catherine University, in Minnesota, offers a concentration in healthcare interpreting. Established in 1983, this concentration offers interpreting students several healthcare electives as part of their course of study (St. Catherine University, n.d.). Additionally, the undergraduate interpreting program at Gallaudet University requires students to complete course work in human biology and anatomy and physiology, however, these courses do not constitute a concentration (Gallaudet University, n.d.). While these courses help prepare interpreters for providing services in healthcare settings, they do not necessarily prepare students to work with Deaf professionals who choose to engage in careers in the medical field that do not involve direct patient care.

In the field of signed language interpreting worldwide there has been no research conducted related to interpreters and the interpreting process in STEM. Anecdotally, however, many Deaf students in higher education and Deaf professionals in STEM experience a lack of qualified signed language interpreters in order to access communication that is necessary to become successful in their respected fields (Cook & Graham, 2012; Graham, Solomon, Marchut, Kushalnagar, & Painter, 2012). Without a clear understanding of what is required for interpreters to provide effective services in the STEM fields, it is impossible to train experienced and student interpreters in the competencies needed. This lack of understanding the competencies required of interpreters in STEM will only further exacerbate the issue of not having enough qualified interpreters to provide services leading to limitations placed on Deaf students wishing to enter the STEM fields and those Deaf professionals who have already started their careers.

Statement of the Problem

Currently, there are no defined and agreed upon competencies that interpreters must possess to provide effective communication access services in the STEM fields. Lack of identified competencies has led to a shortage of qualified interpreters able to provide effective services in the STEM fields, thus causing Deaf professionals to experience limitations that their hearing colleagues do not face. These additional limitations can cause additional stress on the Deaf professional and increase their work load as they seek alternative ways to communicate important job related information amongst their fellow professionals.

Purpose of the Study

The general purpose of this study is to identify the skill set, knowledge base, and other attributes that signed language interpreters must possess in order to provide effective services for Deaf professionals in the STEM fields. To do so involves finding the answers to the following questions: What do Deaf professionals in the STEM fields identify as the competencies signed language interpreters must possess in order to provide effective communication access services in those fields, and, are their enough qualified interpreters to provide effective communication access services in the STEM fields? The identified competencies can then be used as a baseline for professional and student interpreters who wish to enhance their skill set and knowledge base in order to provide effective communication access services in the STEM fields. The identified competencies may further be used to argue that STEM interpreting is an area of specialization within the field and should be officially recognized as such by professional organizations and, possibly, the availability of specialty credentials.

Additionally, if the lack of qualified interpreters who can provide services in the STEM fields is documented with empirical evidence, interpreter practitioners and interpreter educators will acknowledge the need for more training specifically oriented toward interpreter education and skill development in the STEM fields.

Theoretical Bases and Organization

Theoretically, if interpreter competencies in the STEM fields are identified, then interpreter practitioners and interpreter educators can begin to address the issue of a lack of qualified interpreters able to provide services in the STEM fields through directed and specific training. The organization of this study is based on the fact that there are currently no agreed

upon and identified competencies for interpreters providing services in the STEM fields. Additionally, through anecdotal evidence, this researcher assumes that there are not enough interpreters qualified to provide services in the STEM fields and seeks to validate that anecdotal evidence by asking Deaf professionals about their experiences with interpreter services in their respective fields. Identifying interpreter competencies necessary to provide communication access services in the STEM fields and documenting a lack of qualified interpreters able to provide those services will set the foundation for further research related to interpreting in the STEM disciplines.

Limitations of the Study

This study may be limited by a smaller than desired sample size. Although several avenues were taken to distribute the online survey and elicit participation by Deaf professionals, the fact that not every Deaf professional in the STEM fields was aware that their input was sought is a reality. The sample size goal was 100; however, only 57 completed surveys were submitted. A further limitation is the fact that the online survey used to collect data was presented in English only. Deaf professionals in the STEM fields who preferred to participate in the study using American Sign Language (or other signed or written languages) may have chosen not to contribute their input in a non-preferred language.

REVIEW OF RELEVANT LITERATURE

The field of signed language interpreting worldwide is limited by the fact that there has been no research conducted on interpreters and the interpreting process in STEM. However, there are a few qualitative and quantitative research articles that focus on specialty areas that interpreters engage in; mainly the legal, healthcare, and video relay service areas. The research that has been done in these specialty areas can drive the development of signed language interpreting research in the STEM fields.

The need for signed language interpreting services has grown tremendously over the past twenty years due to federal legislation that guarantees a Deaf persons right to communication access services. This need has influenced areas of specialization within the field of signed language interpreting. If interpreters are to provide quality services in the STEM fields to the growing number of Deaf consumers entering those fields there has to be some mechanism to gain the necessary training specific to interpreting in STEM. The consequences of not having qualified signed language interpreters in STEM and not providing necessary training will hamper the professional development of Deaf students and professionals who choose to study and build careers in those fields. Although there is little to no research relating to interpreting and interpreter training in STEM, this literature review will use what little research there is in identified areas of specialization within the field to argue for more research and training in the arena of STEM interpreting.

Existing Specialization in the Field of Signed Language Interpreting

There are several areas of specialization generally recognized by practitioners in the field of signed language interpreting. However, interpreting in legal settings is the only specialty

officially recognized by the Registry of Interpreters for the Deaf (RID) in the U.S. through the provision of credentials above and beyond those of general practitioner. Since 1980 RID has been offering the Specialist Certificate: Legal, commonly known as the SC: L, for practitioners who hold generalist certification and specialize in interpreting in the legal realm. Roberson, Russell, and Shaw (2012) surveyed 1,995 interpreters in Canada and the U.S. regarding their experiences and training for interpreting in legal settings. Of the 1,995 respondents to the 64 question survey, 29.4% held associate degrees, 43% held bachelor degrees and 27.6% held a graduate degree (Roberson, Russell, & Shaw, 2012). Of those surveyed 46% reported working in legal settings with 55.6% of those doing so for 10 years or less (Roberson et al., 2012). The majority of those who indicated they did not work in legal settings cited lack of training as a reason, a concept that will be further explored later in this review. With almost half of the respondents providing services in legal settings, Roberson et al. (2012) speculate that many of those may be under qualified. Deaf people who receive less than par communication access services are subject to dire consequences, especially in the legal realm. Not only should the public be educated on what a "qualified" interpreter in legal settings means, stakeholders must also recognize the need for specific training in this area of specialization (Roberson et al., 2012).

Oldfield (2010) identified Video Relay Service (VRS) interpreting as another area of specialization in the field. VRS is a federally mandated service in the U.S. that allows Deaf people access to telephone interpreting services via live video. Oldfield (2010) interviewed 13 VRS interpreters and VRS managers considered to be experts in the field to tease out specific competencies required for working in VRS that are not required of general practitioners. These experts identified specific competencies that require higher order cognitive processing skills of interpreters, ability to move between subject matters quickly, ability to recognize and use

regional variations in American Sign Language (ASL), and specific technology skills to handle large volumes of calls (Oldfield, 2010). From the results of this study the author was able to develop a competency model for interpreters in the specialty of VRS. According to Oldfield (2010), identifying these competencies will have implications for interpreter preparation programs as the need for qualified VRS interpreters continues to grow at a rapid rate in the U.S. However, it should be noted that due to the low sample rate (13 participants), generalizing the findings of this VRS study may be difficult. Oldfield (2010) recommends future research with a larger sample size to validate the results.

Walker and Shaw (2011) identified six areas of specialization within the field of signed language interpreting by using a mixed method study to survey 120 interpreters from the Southeast region of the U.S. who completed training within the past two years. The interpreters were asked to evaluate their readiness to provide services in (1) legal, (2) medical, (3) mental health, (4) K-12 education, and (5) post-secondary education settings as well as (6) providing services for people who are Deaf-Blind. (Note: this study did not ask participants about their perceived readiness to provide services in the STEM fields.) Through a 93-question survey participants were asked to identify specialty areas that they provided services in at least twice a week. Of those surveyed 52% provided services in post-secondary educational settings, 44% provided services in medical settings, and 41% provided services in K-12 educational settings. Legal and mental health settings, as well as working with Deaf-Blind individuals, were not reported as frequent situations in which the respondents provided services (Walker & Shaw, 2011). The reasons given for not providing services in these areas will be discussed in a later section of this review.

To date there has been no research conducted on interpreting in the STEM fields as a specialty. Therefore, the first step to understanding the need for interpreter specialization and specialized training for interpreting in the STEM fields is to consider the perspectives of Deaf consumers related to interpreting services in the STEM fields.

The Need for Specialization in the Field of Signed Language Interpreting

As Deaf people around the world who use a signed language gain greater access to social and professional services, the need for signed language interpreters who can provide specialized services increases. Looking to the research that has been conducted from the Deaf consumer's perspective sheds light on the need for specialization in the field of interpreting. Middleton et al. (2010) conducted a cross-sectional study to evaluate the needs of Deaf and hard of hearing patients seeking healthcare within the National Health Service (NHS) in the United Kingdom. They surveyed 999 Deaf and hard of hearing people through questionnaires disseminated in several different publications targeting this specific group of consumers. Of the respondents who answered the questionnaire, 11% indicated their preferred mode of communication as a signed language (in this case, British Sign Language) with 15% of respondents preferring to use a qualified interpreter in healthcare settings (Middleton et al., 2010). Respondents reported that access to these interpreters was of utmost importance to receive the information they needed regarding their own healthcare. Middleton et al. (2010) recommended that infrastructure in the NHS should be modified to prove the use of an accredited interpreter before consent can be considered informed.

Here in the U.S., Steinberg, Barnett, Meador, Wiggins and Zazove (2006) found similar results in a qualitative study that analyzed data collected from 91 Deaf participants in four focus

groups conducted in three major U.S. cities. They found that Deaf people continue to report a lack of accessibility to healthcare despite the passage of the ADA in 1990 and there is a general fear of the consequences of miscommunication with healthcare providers (Steinberg et al., 2006). When asked about other means of communication (writing, speech reading, and telephone) participants in the focus groups felt these means were inadequate and the preference was for a medically experienced and certified interpreter (Steinberg et al., 2006). Steinberg et al. (2006) conclude their study with the recommendation that there should be advanced education offered in healthcare interpreting for signed language interpreters and the effects of this education on health outcomes of Deaf people should be studied.

While interpreting in medical settings is considered one aspect of STEM interpreting, we must look to Deaf professionals who have chosen a STEM field as a career path and Deaf students who have chosen STEM majors to gain a better understanding of the need for interpreter specialization in STEM. The National Science Foundation hosted a two day event entitled "Workshop for Emerging Deaf and Hard of Hearing Scientists" May 17-18, 2012 on the campus of Gallaudet University to explore how to increase participation by Deaf and hard of hearing people in the STEM fields (Note: medical professionals were welcome to attend this event, but may not have done so due to having their own conferences hosted by the Association of Medical Professionals with Hearing Loss). The organizing committee used this opportunity to survey the 97 participants who ranged from high school and college students to university professors and government employees. Subsequently, the team who coordinated the event used a mixed methods approach to analyze the data collected which was published in a whitepaper. This report states that many of the challenges faced by Deaf students and professionals are based on access to communication in the various fields and lack of qualified and experienced interpreters to

provide communication access services (Solomon, Ed., 2012). Students reported difficulty in following lectures when interpreters did not have scientific training and struggled with the material being presented through interpreters (Graham, et al., 2012). Deaf professionals who work in the STEM fields reported the same frustration with interpreting services and the inability to participate in workplace events, and sometimes the lab work itself, because of lack of qualified interpreters to provide services (Cooke & Graham, 2012). These findings imply that if Deaf professionals and Deaf students in STEM disciplines are to gain access to communication to further their career, specific training needs to be provided to interpreters to ensure that they are able to provide effective communication in both the classroom and the workplace. Understanding the needs of Deaf consumers in STEM arenas is the first step in validating the need for specialization of signed language interpreters in those settings.

The Need for Specialization Training in the Field of Signed Language Interpreting

Interpreter preparation programs, whether at the two year associate level or the four year bachelor level, train students to become general practitioners. Once a student graduates from a program they should have the knowledge and skills necessary to provide generalist services. However, what about those who wish to provide services in specialized settings? The research shows that there is a need for further training outside of academic programs for interpreters who wish to specialize in certain disciplines (Oldfield, 2010; Roberson et al., 2012; Steinberg et al., 2006; Walker & Shaw, 2011).

In Roberson et al. (2012), the majority of those interpreters who indicated they did not work in legal settings cited lack of training as a reason. Of the 1,995 interpreters who responded to the survey, 72% stated they were interested in taking university classes in legal interpreting for

credit (Roberson et al., 2012). Clearly, there is a need for specialized training in legal interpreting due to the nature of and potential consequences of providing services in this setting. Roberson et al. (2012), state that stakeholders must recognize the need for training in the legal specialty and take steps to establish a core curriculum in order to train interpreters appropriately. Until that can be done the researchers recommend establishing a group of mentors for legal interpreting nationwide and developing a consistent model of training for interpreters who wish to specialize in the legal realm (Roberson et al., 2012). The Distance Opportunities for Interpreter Training, housed at the University of Northern Colorado, is currently the only interpreter preparation program in the U.S. that offers specialized course work to enhance the knowledge base and skill set of interpreters who wish to specialize in legal interpreting (University of Northern Colorado, Distance Opportunities for Interpreter Training, n.d.).

In the study on VRS interpreting as a specialty, Oldfield (2010) identified certain competencies that are required of interpreters who choose to provide services in that venue. Oldfield (2010) states, "A situational analysis shows that sign language interpreter education and development are not producing the number of practitioners needed to keep up with the current demands, much less the predicted demands for the near future" (p. 42). Clearly, this is a call for training interpreters in the specialty of VRS. One recommendation from this article was that the competency model developed as a result of this study be used by interpreter preparation programs to train interpreters in the specialization of VRS (Oldfield, 2010). This recommendation becomes pertinent to the field of signed language interpreting as the need for qualified interpreters in VRS continues to grow.

Walker and Shaw (2011), who identified six areas of specialization for interpreters, note that those interpreters who chose not to provide services in legal and mental health settings and

for persons who are Deaf-Blind cited lack of training. The 56% of respondents who reported not accepting assignments in medical settings also cited lack of training in ASL vocabulary and general medical procedures and they went on to suggest that interpreters receive intensive training in this area before accepting assignments (Walker and Shaw, 2011). In contrast, the respondents indicated that interpreting in educational settings were the most commonly accepted assignments by recent graduates who claimed the training they received was adequate enough that they felt comfortable in those settings (Walker and Shaw, 2011). Walker and Shaw (2011) recommend, based on their findings, that interpreter preparation programs develop curriculum and implement specialized training in the six specialty areas identified. Currently, in the U.S., St. Catherine University's signed language interpreter preparation program offers a concentration in healthcare interpreting. Their program provides interpreting students with several healthcare electives as part of their course of study in order to enhance their knowledge base related to healthcare settings (St. Catherine University, n.d.). Additionally, the undergraduate interpreter preparation program housed at Gallaudet University requires students to take a class in human biology as well as anatomy and physiology (Gallaudet University, n.d.).

Alternatively, what about specialized training for interpreters who would like to provide services in STEM disciplines? There has been no research to date regarding STEM interpreting as a specialty in the field. As such, we must turn to the experiences of Deaf consumers who require interpreting services in STEM. Those experiences clearly show there is a lack of qualified and trained interpreters to provide services (Solomon, Ed., 2012). The lack of qualified and trained interpreters ultimately stems from a lack of formal and standardized training. The report from the "Workshop on Emerging Deaf and Hard of Hearing Scientists" (Solomon, Ed., 2012) makes several recommendations regarding the training of interpreters in STEM: (1) further

research be conducted on how interpreters who are qualified to provide services in the STEM fields gained the knowledge and skills necessary to do so; (2) that interpreter training programs must acknowledge the lack of training for interpreters in STEM fields; and (3) that resources for interpreters who are interested in providing services in the STEM fields be developed. This report may be considered a call for interpreter training in the specialty of STEM and becomes all the more powerful as it comes from the Deaf consumers of interpreting services themselves.

Interpreter Competencies in Healthcare Settings

Swabey and Dutton (2014) published "Interpreting in Healthcare Settings: Annotated Bibliography" in which they provide resources for interpreters in healthcare settings and interpreter educators related to 13 domains and corresponding competencies that are necessary for signed language interpreters providing services in healthcare settings to possess. The 13 domains and corresponding competencies were identified through a joint effort of the CATIE Center (Collaborative for the Advancement of Teaching Interpreting Excellence), housed at St. Catherine University, and their parent organization, the National Consortium for Interpreter Education Centers (NCIEC). Both of these entities are provided funding through the U.S. Department of Education, Rehabilitation Services Administration. Their purpose, along with five other organizations under the NCIEC is, "to significantly increase the number of qualified interpreters available to interpret in vocational rehabilitation and other professional settings" (St. Catherine University, CATIE Center, n.d.). These domains and competencies can serve as a model to base the development of domains and competencies in other specialty areas of signed language interpreting. However, these domains and competencies are geared toward the interpreting practitioner who provides communication access services to healthcare professionals who in turn provide services to Deaf patients, and not for those interpreters who provide

communication access services to Deaf professionals in the healthcare and medical fields. Outside of generalist interpreter competencies, these are the only published domains and competencies for interpreters in a specialized setting.

Conclusions

While there is currently no research published regarding signed language interpreting in the STEM disciplines, this review includes recent research in other specialty settings as a way to stress the need for research in STEM interpreting. Several of the articles reviewed related to research in other specialty areas of interpreting in the field. Roberson et al. (2012) examined the numbers of interpreters who take assignments in the legal realm as well as those who desire specific training to be prepared for legal interpreting. Oldfield (2010) developed a competency model for interpreting in VRS based on the unique needs of that setting. Through their research, Walker and Shaw (2011) identified six areas of specialization in the field of signed language interpreting: legal, medical, mental health, K-12 education, post-secondary education, and working with Deaf-Blind consumers. Research in the area of STEM interpreting could reveal that interpreters need a unique and specific skill set and knowledge base to provide effective services in the STEM disciplines.

Consumer based research (Steinberg et al., 2006; Middleton et al., 2010) outlined the need for interpreters who specialize in medical interpreting both in the U.K. and the U.S. These studies also outlined the consequences for not having properly qualified and credentialed interpreters in medical settings. As for interpreting in STEM, Solomon (Ed.) (2012) reports that both Deaf students and professionals who choose STEM as a career path face barriers to effective communication due to interpreters not possessing the necessary qualifications and

training to provide services in that realm. Knowing that it is difficult to obtain effective communication services in the STEM fields may hamper Deaf people from pursuing an education or career in those fields. Research on interpreting in the STEM fields should focus on the experiences of Deaf students and professionals in the STEM disciplines and their experiences with interpreters to tease out the necessary competencies interpreters must have to provide effective services in those disciplines.

Four of the six articles reviewed (Oldfield, 2010; Roberson et al., 2012; Solomon, Ed., 2012; Walker and Shaw, 2011), offer recommendations for interpreter educators to develop and implement curriculum to train interpreters who want to specialize in specific settings. This recommendation becomes paramount as more Deaf people are exercising their right to communication access in specialized settings and the need for qualified interpreters in those settings grows. While interpreting in the STEM fields is not officially considered an area of specialty within the field of signed language interpreting, identifying the competencies that interpreters should possess to provide effective services in those fields is the first step in moving towards an officially recognized specialization.

METHODOLOGY

The primary purpose of this study is to begin to define what Deaf professionals in the STEM fields consider competencies that interpreters must have in order to provide effective services in those disciplines. This study also documents if there are enough interpreters who are qualified to provide services in the STEM fields. This is exploratory research with the aim of defining and clarifying concepts related to interpreting in the STEM fields since these aspects regarding interpreting in STEM have not yet been studied.

Stebbins (2001) claims, "Social science exploration is a broad-ranging, purposive, systematic, prearranged undertaking designed to maximize the discovery of generalizations leading to description and understanding of an area of social or psychological life" (p. 3). The aims of this study are to describe and understand competencies that interpreters must possess in order to provide effective services to Deaf professionals and students in the STEM fields. The goals of this study align with what Neuman (2000) suggests are the goals for exploratory research: become familiar with the basic facts, settings, and concern; create a general mental picture of conditions; formulate and focus questions for future research, and; generate new ideas, conjectures, or hypotheses. While this study cannot be all encompassing, it can lay the ground work for future exploratory, explanatory, and applied research regarding what is required of interpreters who choose to provide services in the STEM fields.

Literature Review

Due to no research on signed language interpreter competencies in the STEM fields or the supply of qualified interpreters in those fields, the researcher analyzed the literature that has been published regarding other specialty areas in the field of interpreting. The literature review

outlined various settings and situations in the interpreting field that are, or should be, considered to require a skill set and knowledge base beyond that of a generalist practitioner. Special attention was paid to how the relevant research addressed the need for training interpreters in the specialty areas identified. Further, understanding how these areas are identified will, hopefully, drive the future identification of STEM interpreting as a specialty in the interpreting field and how interpreters are trained and educated to develop the necessary competencies to provide effective services in those fields.

Design of the Investigation

In order to understand what Deaf professionals identify as competencies for signed language interpreters in STEM, a survey instrument was developed and administered through SurveyMonkey (see Appendix B). The survey consisted of 33 questions composed of three types of items: forced answer questions, "check all that apply" questions, and open-ended questions. These items appeared in four sections of the survey: (1) demographics, (2) use of interpreting services, (3) use of Video Relay Services (VRS) and Video Remote Interpreting (VRI) services, and (4) interpreter competencies in the STEM fields.

The first section on demographics elicited information regarding sector of employment: academia, private, and public. Public places of employment included municipal, state, or federal governments. This section also allowed participants to identify in which STEM field or fields they worked and what their exact disciplines were. STEM fields are the broad categories of science, technology, engineering, and mathematics; whereas discipline refers to the specific area that Deaf professionals are engaged in within the broader categories. For example, the discipline of marine biology is under the category of science; or, the discipline of aerospace engineering is

under the category of engineering. Additionally, the participants were asked about their geographic location in order to help establish if there are any geographic trends as far as having enough interpreters to provide services in STEM.

In the second section on use of interpreting services, participants were asked how often they used interpreting services during a typical work week and in what specific situations they used these services. Participants were also asked questions regarding coordination of interpreting services, if their preference of interpreters was honored, and if they used designated interpreters or a team of designated interpreters. Additionally, respondents were asked questions regarding the quality of interpreting services they receive and how interpreters are secured for assignments.

In the third section, participants were asked about their use of VRS and VRI services. If participants used VRS and/or VRI services they were asked to indicate their satisfaction with these services. The purpose of this section was to determine if Deaf professionals felt these off-site service options were viable for their communication needs.

The fourth and last section of the survey asked participants several questions related to interpreter competencies. Each question included a comment section to allow participants to expand on or explain why they felt certain competencies were essential or not. The questions in this section were devised based on the researcher's own experience and observation, having provided interpreting services to both professionals and students in a variety of STEM fields and disciplines for more than 20 years. The survey instrument was piloted with a group of Deaf professionals and hearing signed language interpreters who identified as providing services in STEM. Questions on the survey were then edited and finalized based on suggestions from the pilot group.

The survey questionnaire was administered on-line through SurveyMonkey using a snowball or networking approach with a link being sent to various individuals who have access to email lists and list-servs of Deaf professionals in STEM including the Association of Medical Professionals with Hearing Loss, the National Technical Institute for the Deaf (various departments), Gallaudet University (various departments), and various social media sites catering to Deaf professionals in STEM. Additionally, the link to the survey was sent to certain Deaf professionals in STEM who the researcher has worked with in the past. These individuals were asked to share the link with other Deaf professionals in STEM in their own personal and professional networks. The survey was anonymous with no identifying information being collected.

Sample

A total of 79 Deaf professionals in STEM responded to the survey; however, only 57 completed the survey in its entirety. For the purposes of this study only the data from the 57 completed surveys was analyzed and reported. Respondents were mainly from the U.S. with one person reporting currently working in Canada.

Data Analysis Procedures

The data from the survey was transferred to an Excel spreadsheet then coded and analyzed using both qualitative and quantitative methods. A qualitative method consisting of coding data from open ended questions was used to discover common trends and to further flesh out the specific competencies that were identified. Comments from participants on forced answer questions were also coded and sorted to identify trends not captured in the responses to the questions. These comments helped in understanding why respondents reported the way they did

in the forced answer questions. For example, those who reported that it was not important that interpreters have the ability to decipher the accents of non-native English speakers indicated that they did not work with non-native English speakers in their discipline. This type of qualitative analysis is based in grounded theory which seeks to identify relationships between categories coded and inductively develop a theory that explains the phenomena being studied (Strauss & Corbin, 1990). For the purposes of this study, the grounded theory approach was the best way to understand why participants ranked interpreter competencies as they did.

A quantitative method was used to note the frequency with which respondents ranked the importance of interpreter competencies. This method was also used to report the data collected from the forced answer questions on the survey. Using a qualitative method, correlations between different variables within the study were also explored. Further Excel spreadsheets were created to compare specific responses side by side to determine any trends that the data revealed. For example, a comparison was made between those who reported working in academia and their responses to the question regarding if there are enough interpreters in the area to provide effective services. This type of comparison was essential for several aspects of this study and helped to create a generalized picture of what Deaf professionals in STEM experience with interpreting services. Data is reported using both tables and figures.

The strength of conducting exploratory research on interpreting competencies in STEM is to discover general ideas of what is required of STEM interpreters. The qualitative methodology used is limited by the fact that some of the concepts identified could not be well defined. For example, many respondents commented that it was important for interpreters to be professional and have a positive attitude, however, without interviewing those respondents who made the comments it is impossible to determine exactly how they define being professional and having a

positive attitude. A foundation will be laid for future research based on the general findings of these competencies for interpreters in the STEM fields and to later explore the means and ways that these competencies can be acquired by both interpreting practitioners and students of interpreting.

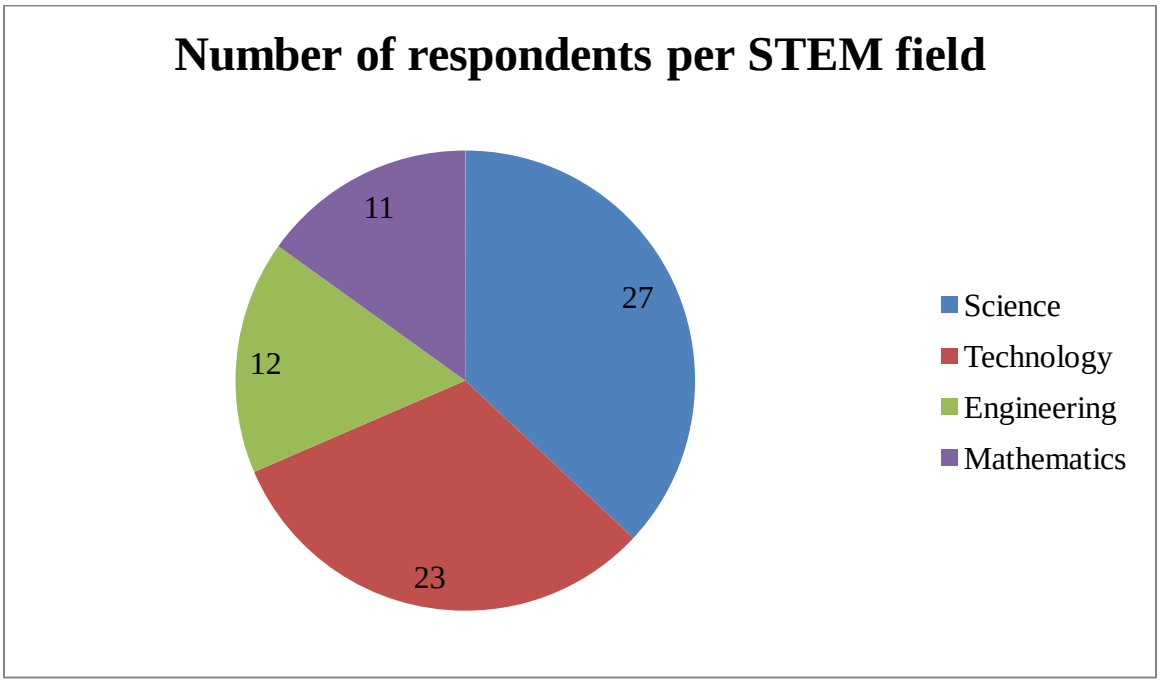
FINDINGS

I. Demographics

Fields and disciplines

Respondents were asked to identify in which specific STEM field they worked and were allowed to check more than one field (Figure 1). Twelve of the respondents did indicate they worked in two or more of the STEM fields. The field of science also includes those who work in the medical and healthcare fields and the field of technology includes those who work in computer and information technology.

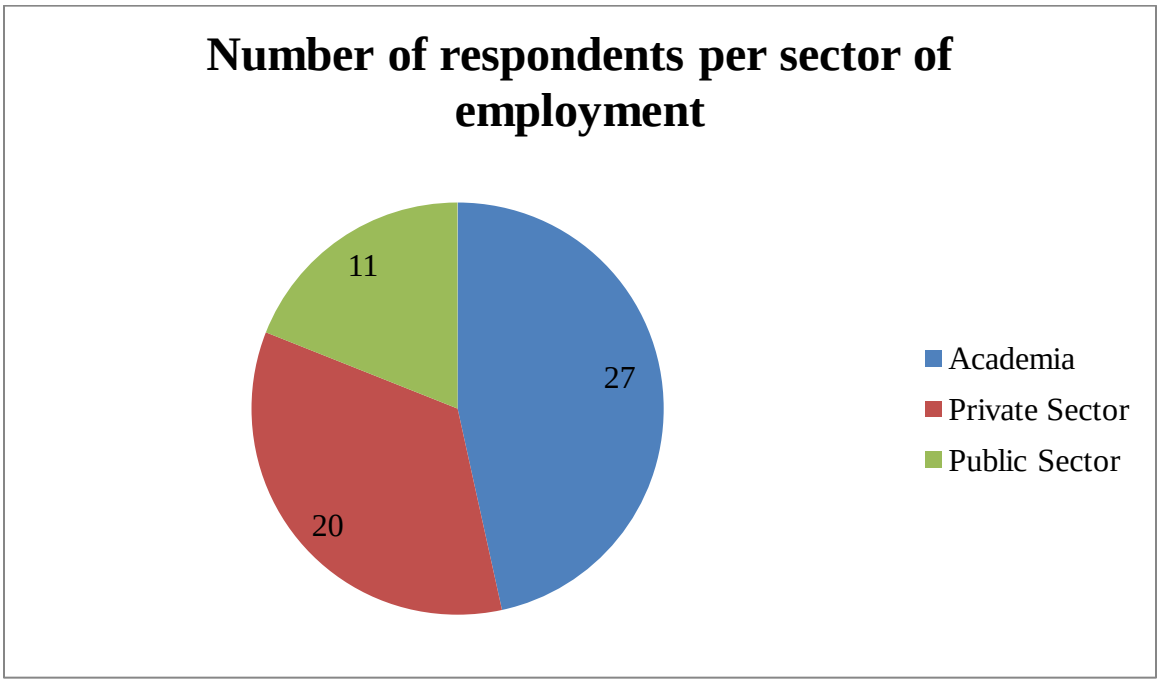
Figure 1. Number of respondents per STEM field.



Sectors of employment

Respondents were asked to identify in which sector they were employed: Academia, Private Sector, or Public Sector (including government) and were allowed to choose more if they worked in more than one sector (Figure 2). Four respondents indicated they worked in more than one sector. The data collected for this question was also used to correlate with how respondents answered the question about having enough qualified interpreters in their area to provide communication access services in their discipline (see Figure 9).

Figure 2. Number of respondents per sector of employment



Geographical areas

Participants were asked in which region or state they worked to gain an understanding of where Deaf professionals in the STEM fields are located. The West Coast region (CA, OR, WA) and the Northeast region (MA, NJ, NY, VT) garnered the most responses, 15 participants and 14 participants respectively. The Midwest region (Canada, IA, MI, MN, OH) and the East Coast region (MD, Washington DC) are also well represented with 10 respondents and 9 respondents respectively answering the survey. All respondents indicated living in North America.

Table 1. Geographical location of respondents.

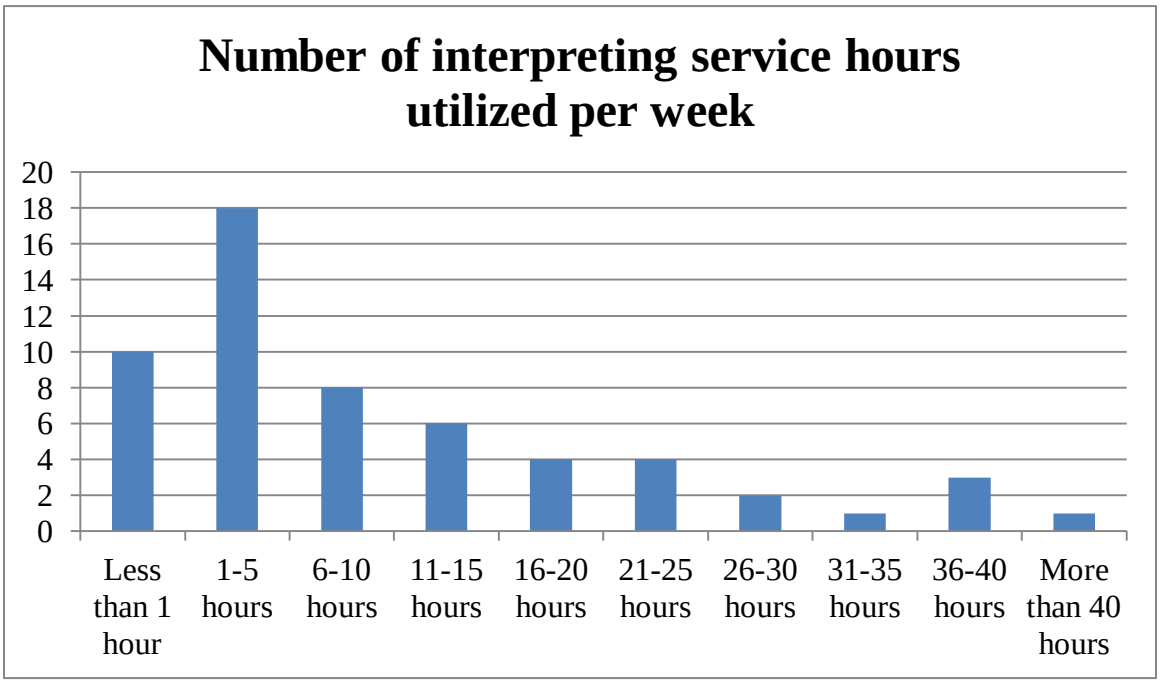
Geographical Location of Respondents	Number of Respondents
West Coast (CA, OR, WA)	15
Northeast (MA,NJ, NY, VT)	14
Midwest (Canada, IA, MI, MN, OH)	10
East Coast (MD, Washington DC)	9
South (FL, LA, TX)	6
Southwest (AZ, CO, NM)	3
Total	57

II. Interpreting Services

Frequency of use of interpreting services

The majority of respondents, 31.5% (18), reported that during a typical work week they used between one and five hours of interpreting services (Figure 3).

Figure 3. Number of interpreting service hours utilized per week.



Situations where interpreters are used

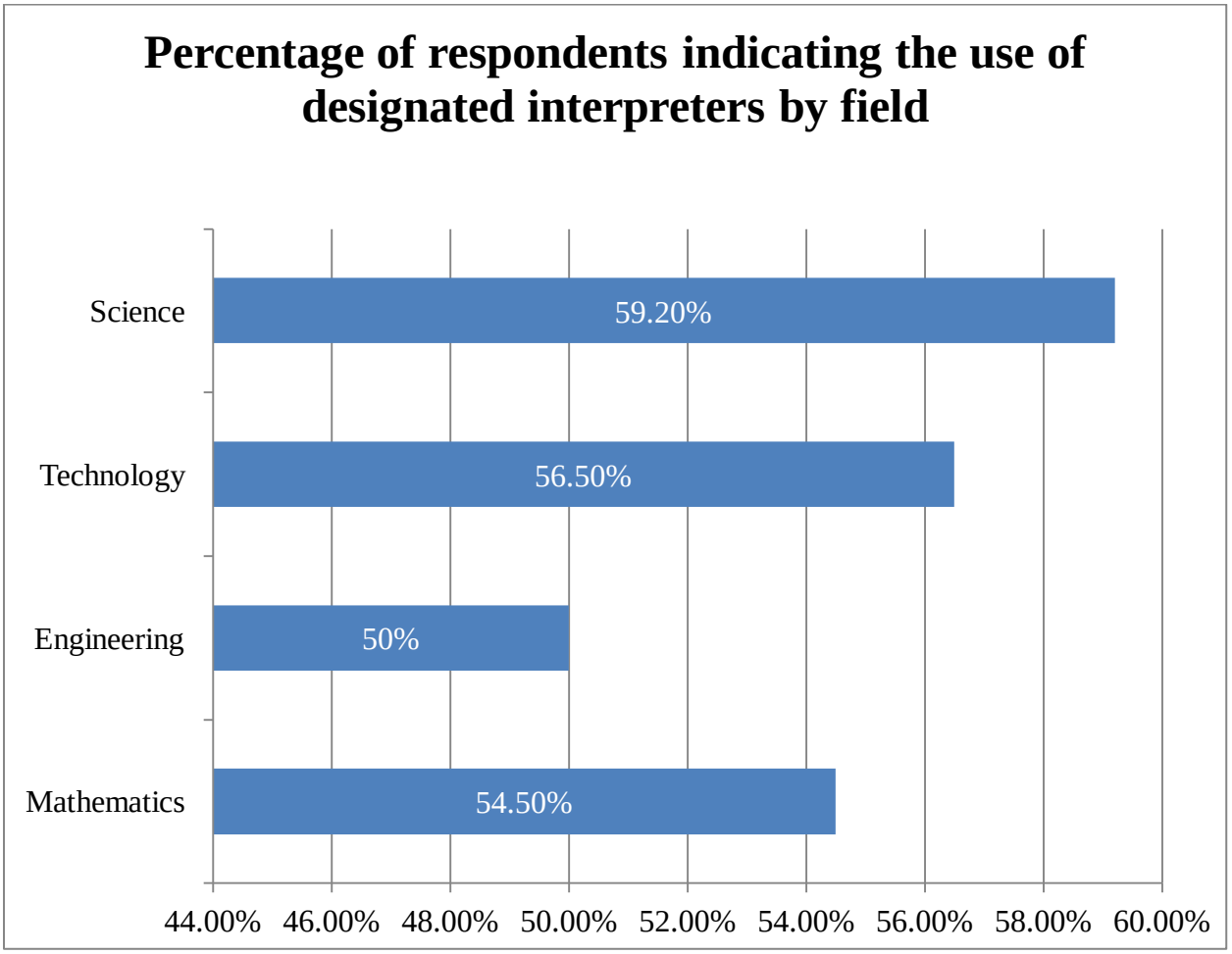
Deaf professionals in the STEM fields reported using interpreting services in a wide variety of settings depending on the sector in which they are employed and their specific discipline. The most common settings where interpreting services are utilized are large group meetings, classroom settings, one-on-one meetings, presentations, conferences, trainings, patient care, and employment specific events. Of the respondents in this study, 41 indicated the use of

interpreting services for group meetings, 16 reported the use of interpreting services in classroom settings for lectures and guest speakers, 15 indicated using interpreting services for one-on-one meetings at their place of employment, and 13 indicated using interpreting services for employment specific presentations by colleagues and superiors. Furthermore, seven respondents indicated the use of interpreting services for employment specific conferences, five reported using interpreting services for employment specific training, and four indicated the use of interpreting services for employment related events. Additionally, four of the respondents indicated using interpreting services for direct patient care.

Designated interpreters

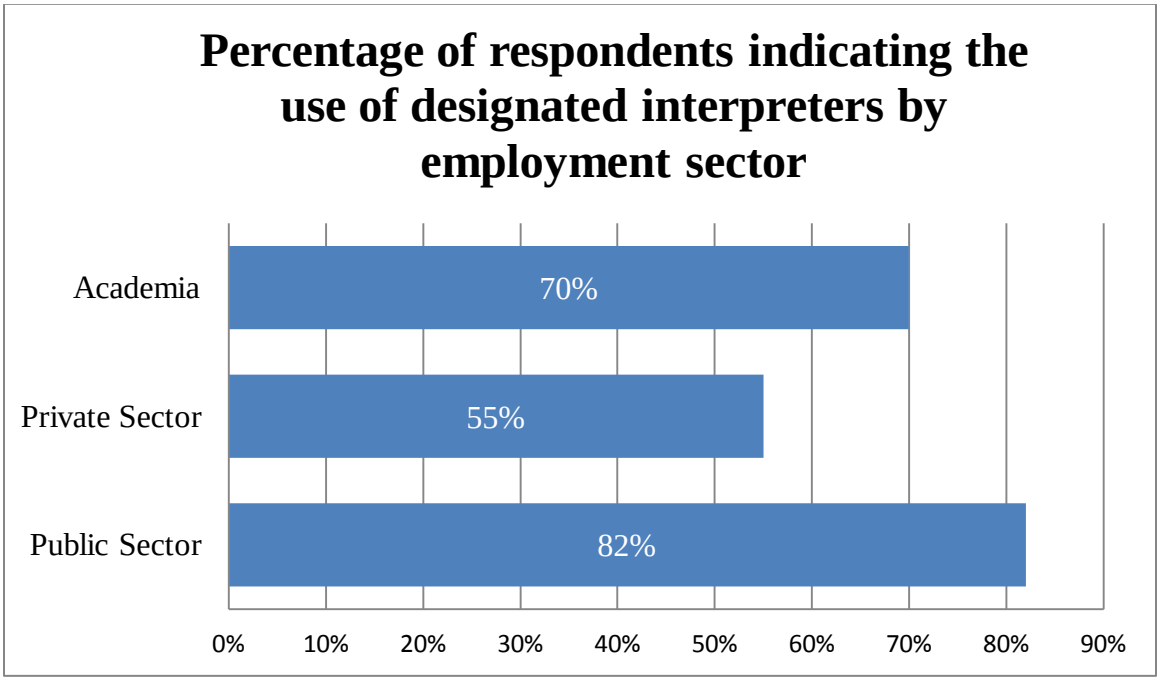
Designated interpreters are those interpreters who provide consistent and on-going services to specific clients on a regular or semi-regular basis (Hauser, Finch, & Hauser. Eds., 2008). For example, a Deaf doctor may have a designated interpreter (or team of interpreters) whom they use for all situations in which communication access services are needed. The use of designated interpreters ensures consistency across communication events and lessens the need for Deaf professionals to "train" every new interpreter who is employed to provide services. The data collected on the use of designated interpreters was analyzed by field and by employment sector to gain a better understanding of where designated interpreters are utilized as a strategy for the provision of consistent services. The data indicates that 50% or more of Deaf professionals in the STEM fields use designated interpreters and that 55% or more of Deaf professionals in all employment sectors use designated interpreters (Figure 4).

Figure 4. Percentage of respondents indicating the use of designated interpreters by field.



This data was also analyzed to show how many respondents stated they used designate interpreters by their identified employment sector. Fifty-five percent or more indicated the use of designated interpreters across all employment sectors (Figure 5).

Figure 5. Percentage of respondents indicating the use of designated interpreters by employment sector.



The data collected was then combined to ascertain in which sector of employment per STEM field Deaf professionals are using designated interpreters (Figure 6). In the science fields 94% of those who work in academia reported the use of designated interpreters (n=16), with the remaining 6% not identifying in which sector they are employed.

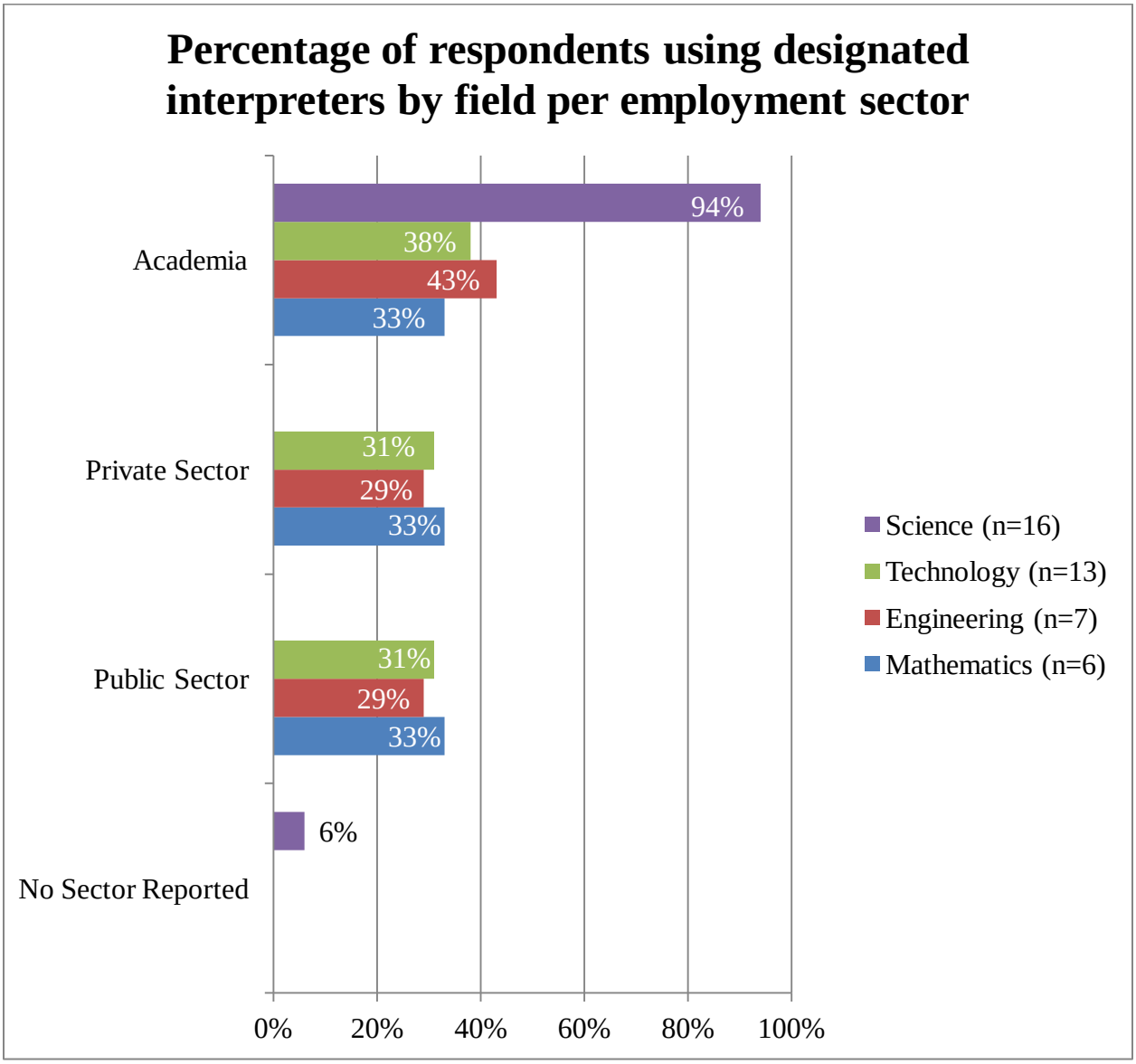
Of those who reported being employed in the field of Technology, 33% reported using designated interpreters in the private and public sectors while 38% of those in academia reported using designated interpreters (n=13).

Using designated interpreters in the field of Engineering was similar to what was reported for their use in Technology across employment sectors (n=7). However, the number using

designated interpreters in academia was slightly higher while the numbers in the private and public sectors was slightly lower.

For those respondents reporting working in the field of Mathematics, 33% use designated interpreters in each of the employment sectors (n=6).

Figure 6. Percentage of respondents using designated interpreters by field per employment sector.



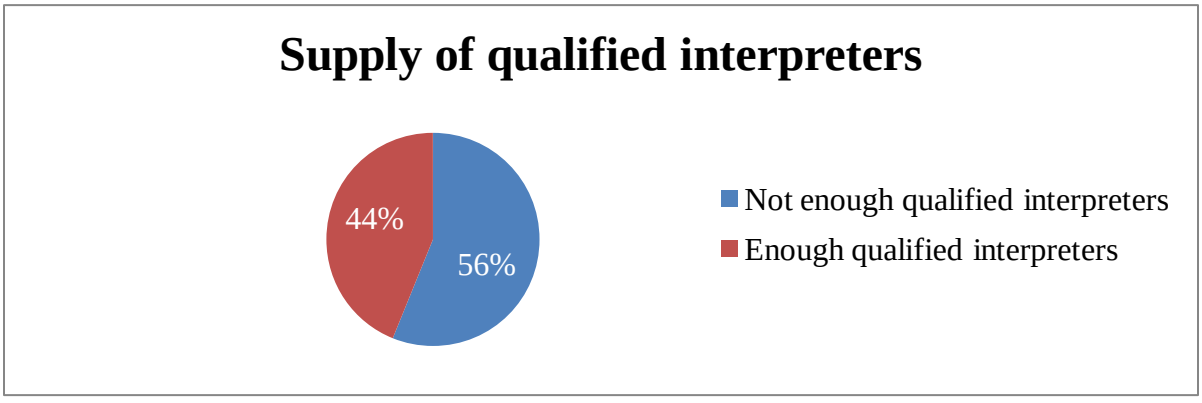
Difficulties of securing interpreters

Participants were asked, "What is the most difficult aspect for you in getting interpreters at your place of employment?" The most difficult aspect reported was a lack of qualified and/or skilled interpreters with 17 respondents stating this as an obstacle. Last minute schedule changes and last minute requests were cited by ten respondents as the second most difficult aspect of securing interpreters while nine reported the difficulty being educating employers as to why interpreting services are needed and their obligation to provide interpreting services in compliance with the ADA. Interpreter availability was mentioned seven times as being a reason for difficulty in securing interpreting services while only six respondents indicated that cost of interpreting services was a factor contributing to difficulty in obtaining services.

Supply of qualified interpreters

Of the 57 respondents to the survey 56% (32) indicated there were not enough qualified interpreters in their area to provide communication access services in their discipline while 44% (25) reported that there were enough qualified interpreters in their area (Figure 7).

Figure 7. Supply of qualified interpreters reported by respondents.



This data was divided by those reporting not enough interpreters by field (Figure 8) and those reporting not enough interpreters by employment sector (Figure 9) to hone in on where the lack of qualified interpreters has the most impact.

Figure 8. Percentage of respondents reporting not enough interpreters by field.

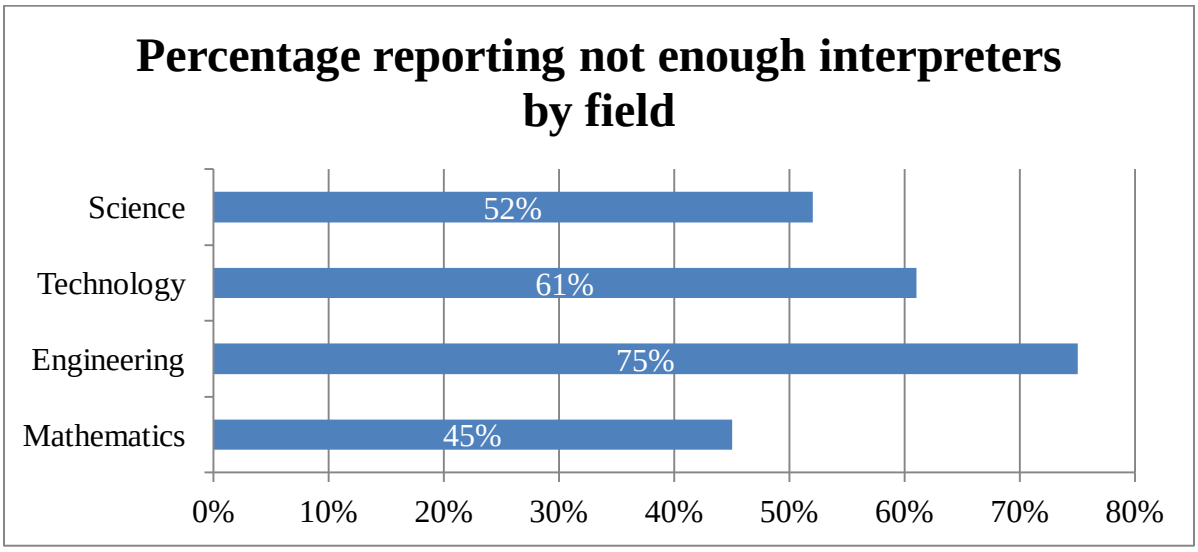
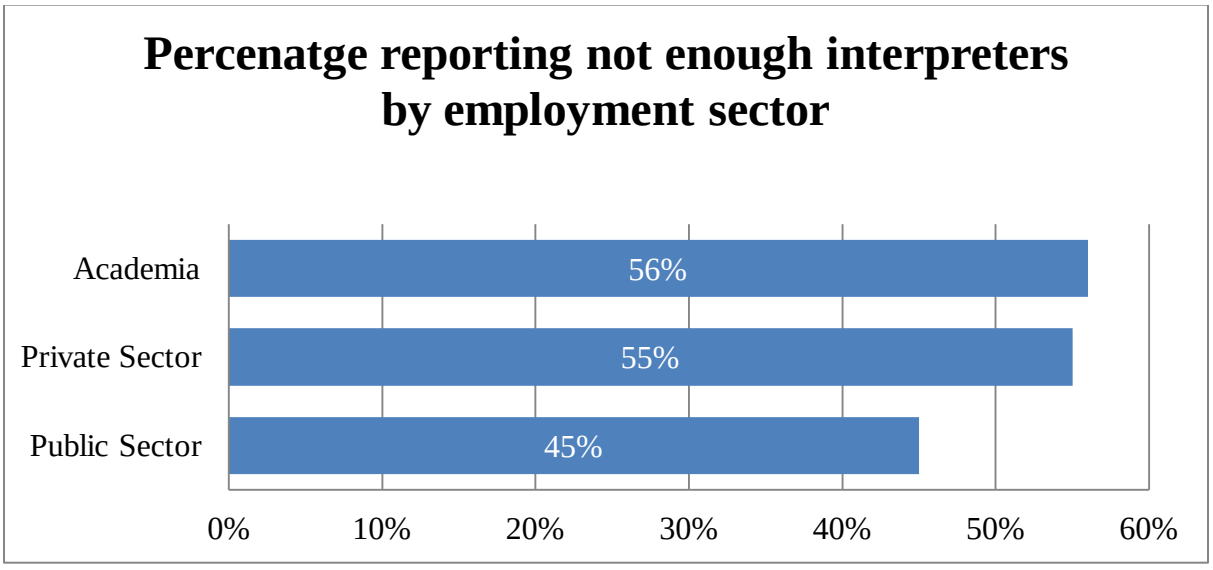
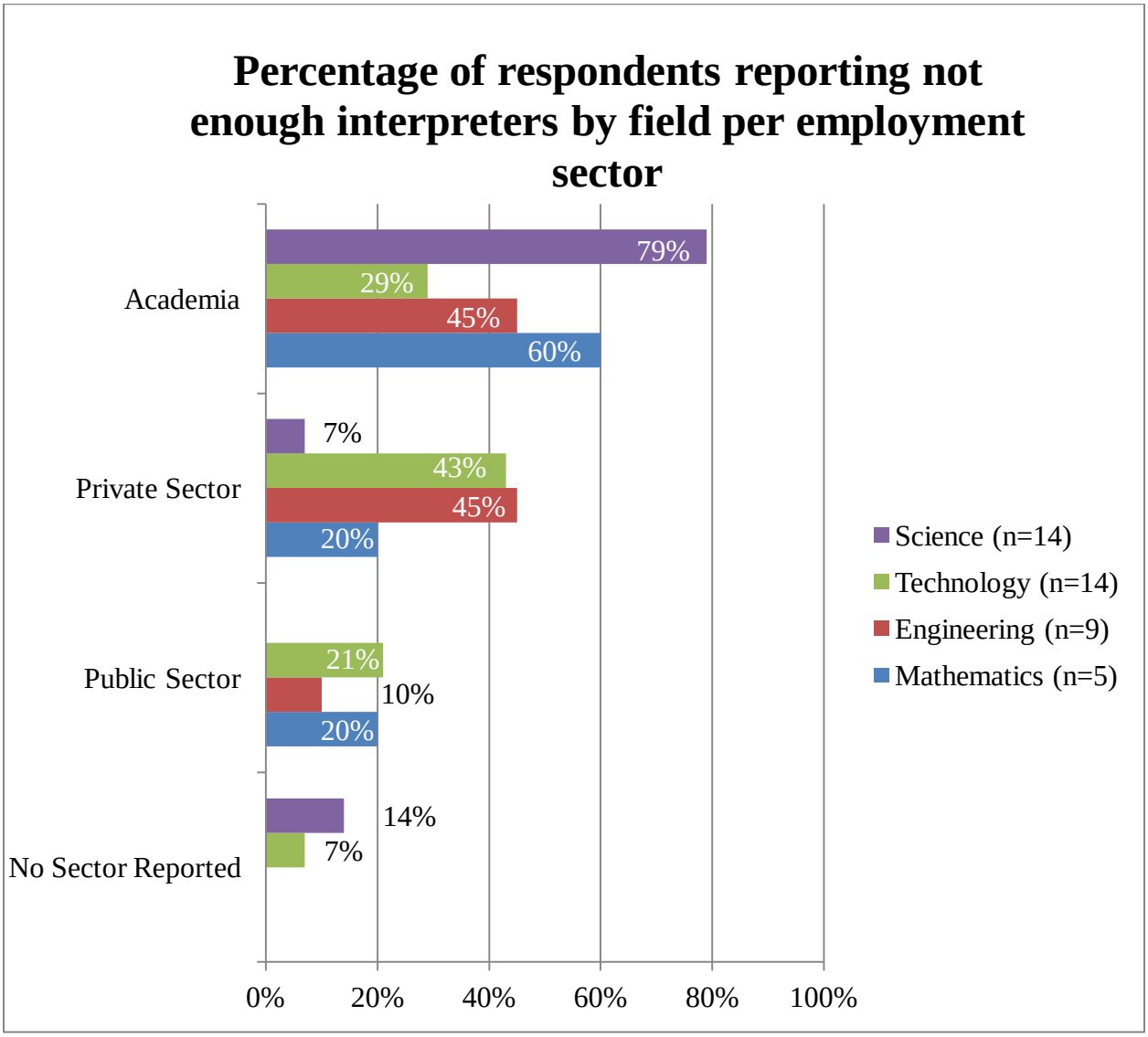


Figure 9. Percentage reporting not enough interpreters by employment sector



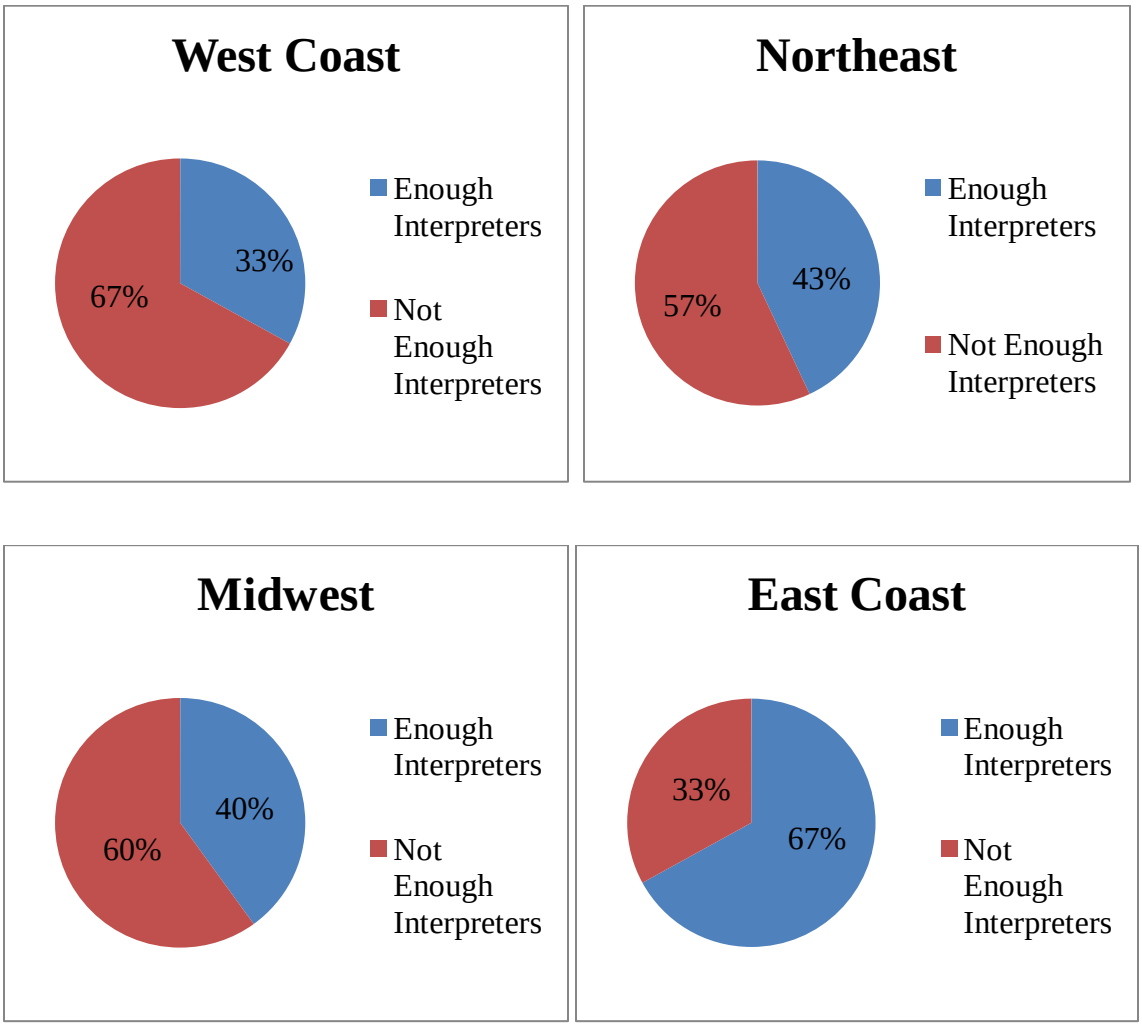
This data was further analyzed to compare the percentage of respondents in each STEM field reporting a lack of qualified interpreters by employment sector to better pinpoint where exactly the shortage of interpreters is most reported (Figure 10).

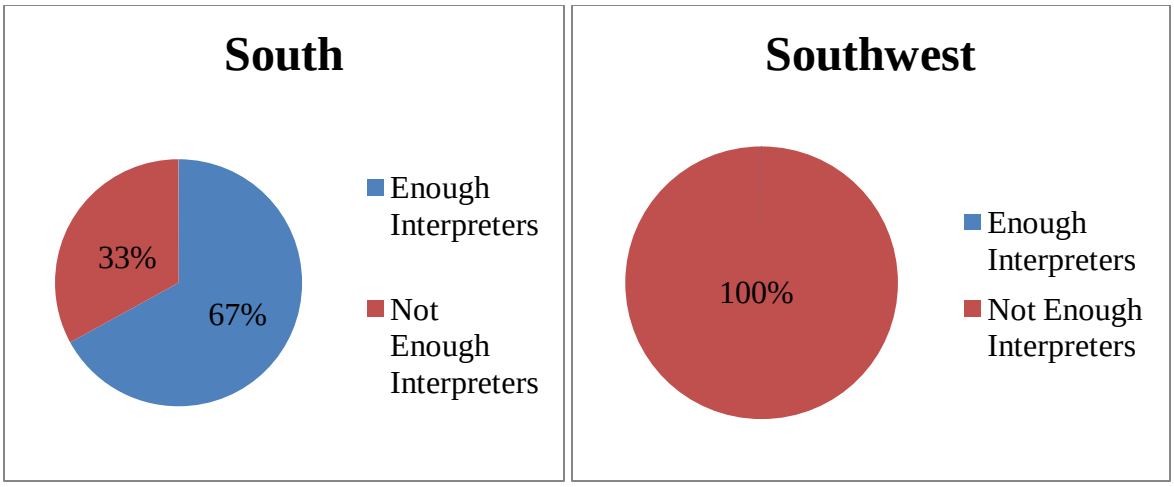
Figure 10. Percentage of respondents reporting not enough interpreters by field per employment sector.



The data reported regarding the lack of interpreters was also analyzed by the regions the participants indicated they were from in order to determine if there was a geographical pattern to the reported shortage of interpreters (Figure 11).

Figure 11. Reported lack of interpreters by region.





III. Video Relay Services and Video Remote Interpreting Services

Use of VRS

Respondents were asked if they used VRS at their place of employment to make work related calls and if they were satisfied with the services they received via VRS interpreters. There were 36 respondents, or 61%, who indicated they did use VRS for work related calls (Figure 12) with 21 (58%) of those being satisfied with the services they received and 15 (42%) being dissatisfied (Figure 13).

Figure 12. Percentage reporting using VRS to make STEM related calls.

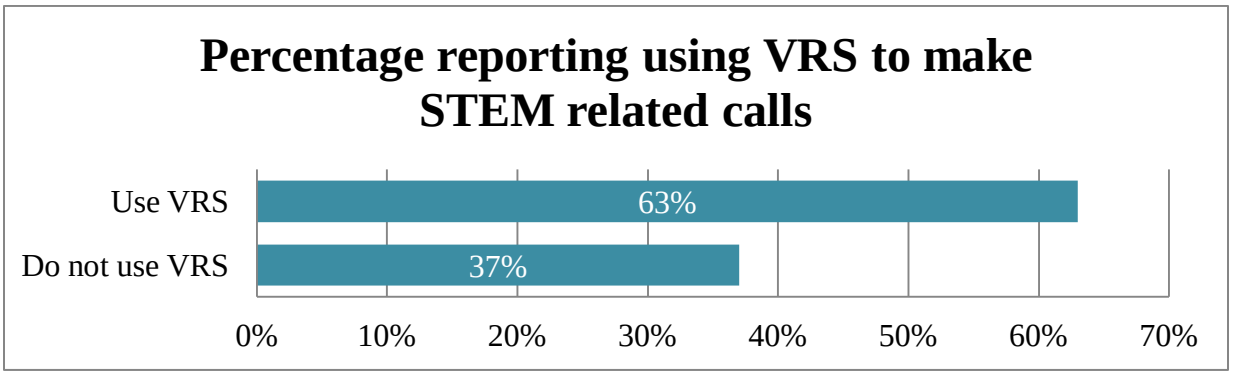
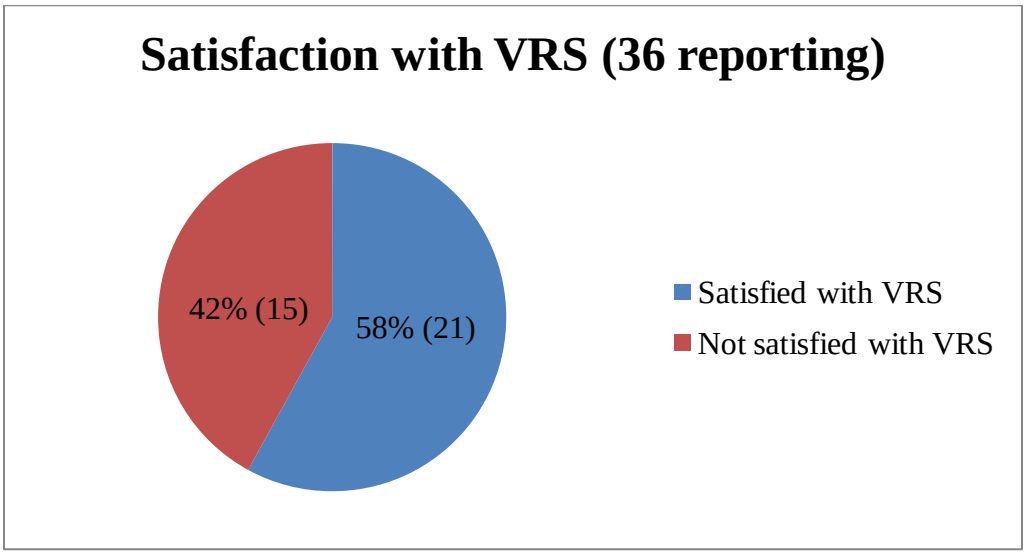


Figure 13. Percentage reporting satisfaction with using VRS for STEM related calls.



Many of the respondents commented that they frequently used email or instant messaging to conduct work related business and used VRS only if they needed to make immediate contact with a colleague.

Use of Video Remote Interpreting Services

Video Remote Interpreting (VRI) is a service in which video technology is used to live stream an interpreter, via computer or other technology device, to a location where a Deaf and hearing person need to communicate. Unlike VRS, VRI is not mandated or reimbursed through the federal government in the U.S. VRI is simply an option to provide interpreting services remotely in which the interpreter does not have to be in the same location as the consumers of services. Seven of the 57 respondents in this study reported using VRI at their place of employment for interpreting services. Of those seven, four were satisfied with the services they received and three reported being unsatisfied with the services they received through VRI. Those

who reported being unsatisfied commented that their lack of satisfaction had to do with technology issues (slow internet speed, choppy video) rather than issues with the quality of interpreting services.

IV. Interpreter Competencies

Respondents to the survey were asked to rate the importance of interpreters' possessing certain competencies when providing services in the STEM fields. In addition to ranking the importance of interpreters' possessing these competencies, respondents were given the opportunity to provide comments specific to different competencies. Through these comments other desirable traits that interpreters should posses came to light, mainly professionalism and a positive attitude. The competencies asked about are as follows:

1. What credentials do you prefer interpreters in your discipline to have?
2. How important is it to you that interpreters in your discipline are flexible interpreting in a range from signed English to ASL?
3. How knowledgeable do you prefer interpreters to be in your discipline?
4. How important is it to you that interpreters have prior experience interpreting in your specific discipline?
5. What type of educational background do you prefer interpreters to have in your specific discipline?
6. How important is it to you that interpreters have training (e.g., workshops, classes, seminars) for interpreting in your specific discipline?

7. How important is it to you that interpreters understand the specific vocabulary and jargon unique to your discipline?
8. How important is it to you that interpreters in your discipline are able to decipher foreign language accents?
9. When your colleagues present a paper or research or lead a meeting at your place of employment or a conference, how important is it to you that interpreters do preparation work beforehand?
10. When you present a paper or research or lead a meeting at your place of employment or a conference, how important is it to you that interpreters do preparation work beforehand?
11. When interpreters in your discipline encounter concepts they do not understand while interpreting, how do you expect them to address the issue?
12. How important is it to you that interpreters in your discipline be flexible with differing work environments (e.g., field work, lab meetings, research cruises)?
13. What are other competencies or skills that you feel interpreters in your discipline must possess that have not been mentioned in this survey?

Participant responses to these questions regarding competencies were analyzed and tabulated and are presented below in table, figure, and narrative format.

Credentials

An interpreter's certification is often used as a measure of their qualification to provide services for any given assignment. In the U.S. and Canada, there are several different certifications that interpreters may or may not possess. As well, there are different certifying bodies that evaluate interpreters using their own unique tests and testing materials. These

differing certifications may be confusing for the general public when it comes to hiring an interpreter to provide services.

The preferences for specific interpreter credentials are quite varied amongst Deaf professionals in STEM (Table 2). Respondents were asked, "**What credentials do you prefer interpreters in your discipline to have**?" They were given the choice of "RID Certification," "NAD Certification," "BEI Certification," "EIPA Credentials," "Other (please specify)" and "Certification does not matter." Respondents were instructed to choose all that apply.

Table 2. Preferred interpreter credentials.

Credential	Number of Responses
Only checked RID Certification	15
RID and NAD Certification	12
Certification does not matter	10
RID, NAD and BEI Certification	7
RID and BEI Certification	4
RID and NAD Certification and EIPA	2
RID Certification and EIPA	2
RID, NAD, BEI Certification and EIPA	1
RID Certification and Certification does not matter	1
NAD Certification and Certification does not matter	1
Only checked BEI Certification	1
Only checked EIPA	1
Only checked NAD Certification	0

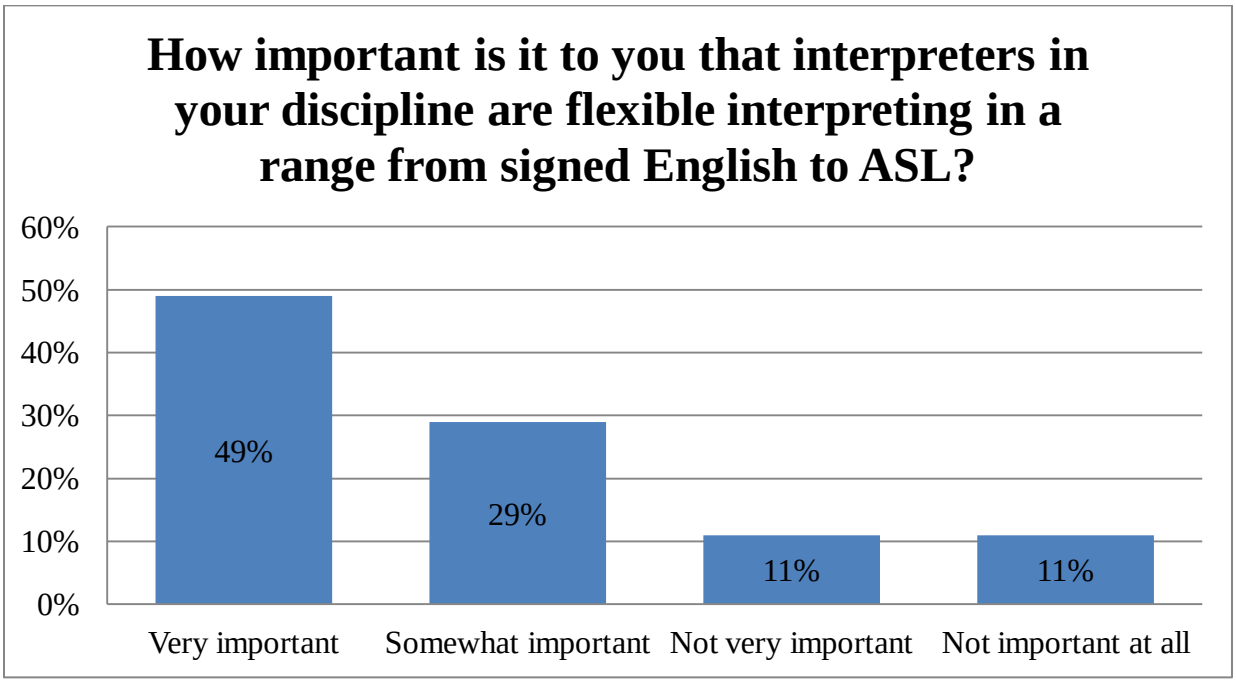
The Deaf professionals in STEM who responded to this survey indicated that they are conscious of the fact that regardless of the interpreter's certification, such credentials are only a measure of an interpreter's minimum skill level. Many respondents commented that they placed more value on the interpreter's ability and aptitude than on what certification they possessed. In regard to interpreter aptitude one respondent stated, "I would rather hire based on experience and motivation/commitment, as well as understanding of the nature of working for a Deaf medical professional, than a mere certification." Along the same line, another respondent made this comment, "Credentials are important, but most important are knowledge of content in order to avoid incorrect conceptual signs in STEM." Yet another respondent reiterated this theme, "They need to be able to handle the content. No certification predicts that." Related to interpreter attitude, one respondent made this comment, "Credentials are important, but experience and attitude usually count as much." Finally, another respondent emphasized, "Attitude and skill are far more important than certification."

Flexibility in signing

Respondents were asked, "**How important is it to you that interpreters in your discipline are flexible interpreting in a range from signed English to ASL**?" Several of the respondents who added a comment to this question indicated a preference for interpreters to use English based signing, or transliteration, while providing services specifically for the person's job task. However, these same participants preferred the use of ASL, or interpreting, in more casual settings such as meetings, social times, or the lunch hour with colleagues. Forty-nine percent of the respondents indicated that it was very important for interpreters in their discipline to be able to interpret in a range of signing modalities that include more English based signing to a more formal ASL structure while another 30% indicated that it was somewhat important. The

remaining 21% indicated that it was either not very important or not important at all to them that interpreters be able to use a range of signed English to ASL when providing services.

Figure 14. Reported importance of interpreters' flexibility in using a range of signing systems.



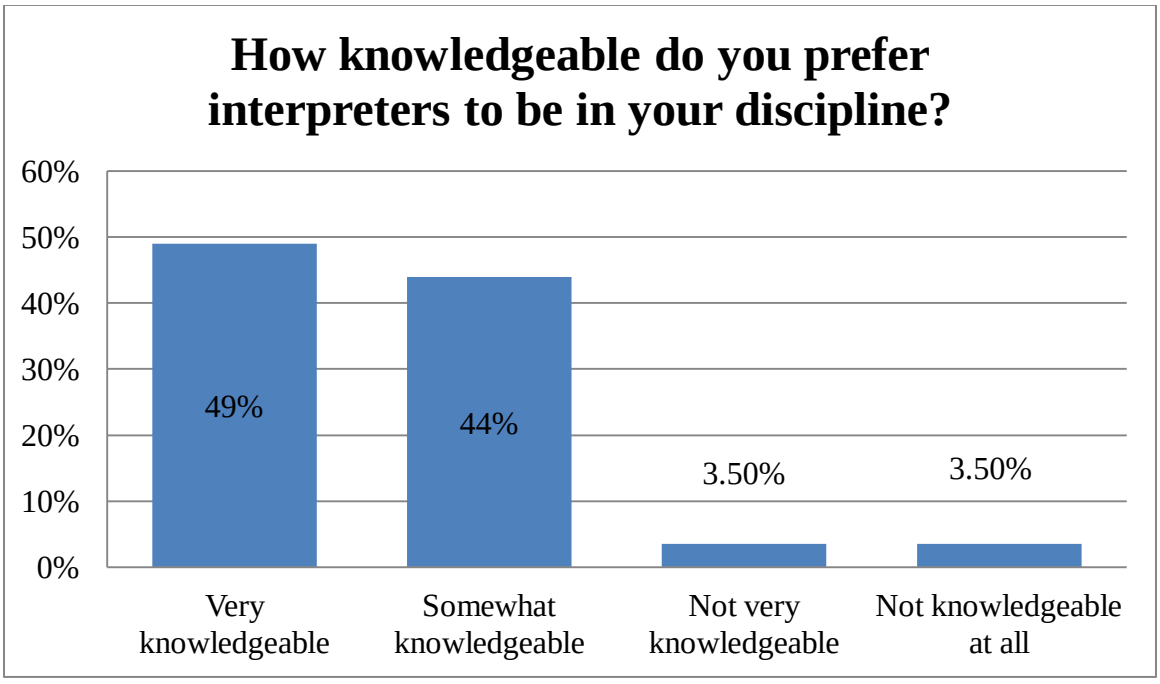
Knowledge of the discipline

An overwhelming majority of respondents reported that it was either very important or somewhat important for interpreters to be knowledgeable in the discipline in which they are interpreting; forty-nine percent and 44% respectively (Figure 15). Many of the respondents also commented on the importance of the interpreter having knowledge in their specific field. One respondent stated, "Nothing is more important than content knowledge." Another respondent commented on the expectation that interpreters have knowledge of the discipline, "The ideal, of course, is to be very knowledgeable! Reality, on the other hand..." Finally, one respondent

emphasized the potential consequences if interpreters are not knowledgeable at all in the discipline by stating, “If the interpreters don’t understand, they make me look stupid in front of people I work with.”

Several respondents also indicated through their comments that they did not expect the interpreters to have specific knowledge when they came into their discipline, but they did expect them to gain knowledge of the field by doing preparation work and being willing to be trained by the Deaf professional. This preparation work and willingness to be trained in the specific discipline is essential for those interpreters who have never experienced working in STEM settings or who are not knowledgeable of the subject matter.

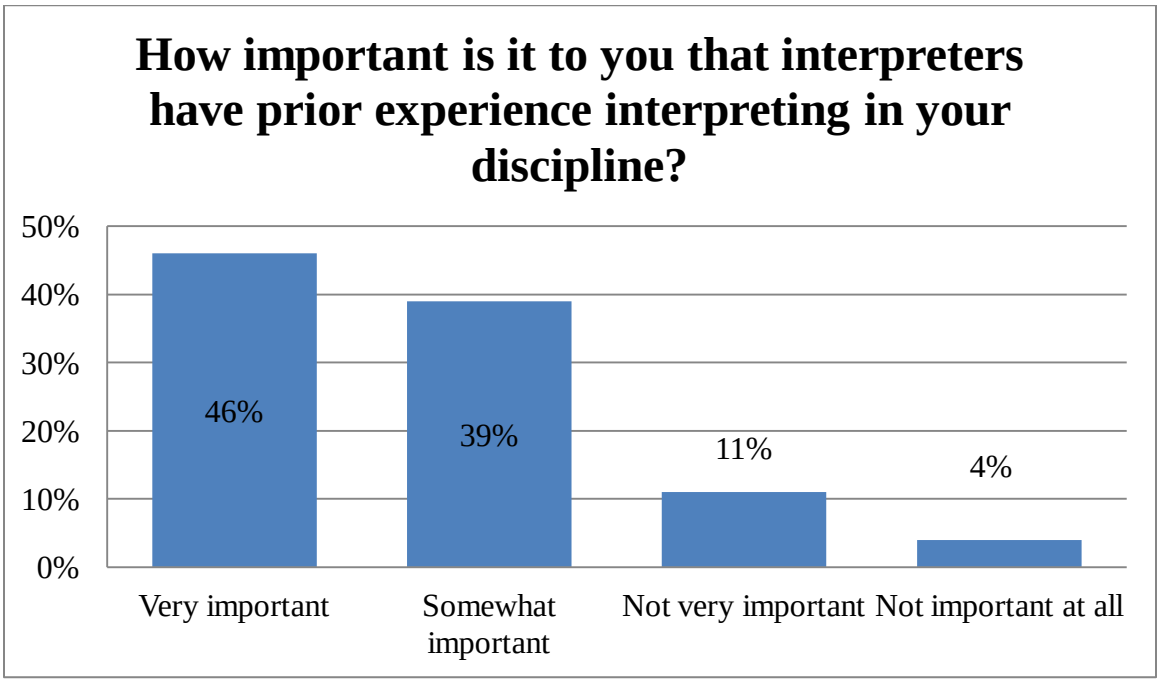
Figure 15. Importance of interpreters being knowledgeable in the discipline.



Prior experience interpreting in the discipline

Eighty-four percent of the respondents indicated that it is either very important or somewhat important for interpreters to have prior experience interpreting in their specific discipline (Figure 16). The remaining 16% indicated that it was not very important or not important at all for interpreters to have prior experience interpreting in their discipline. Not surprisingly, many of the respondents claimed that it was almost impossible to find interpreters with prior experience in their field and they resorted to training the interpreters they worked with.

Figure 16. Importance of prior experience interpreting in the discipline.



Interpreter education and training

Respondents were asked what type of general educational background they preferred interpreters have that was not necessarily specific to the respondents' discipline. While the majority preferred interpreters to have at least a four year degree, the answers varied (Table 3).

Table 3. Preferred interpreter educational background.

Educational Background	Number of Responses
At least a four year degree	24
Some educational background	15
At least a two year degree	8
No educational background	6
At least graduate level education	4

When asked how important it was for interpreters to have training for interpreting (e.g., workshops, classes, and seminars) in the respondent's specific discipline, the numbers tell a different story (Table 4).

Table 4. Reported importance of interpreter training in the specific STEM discipline.

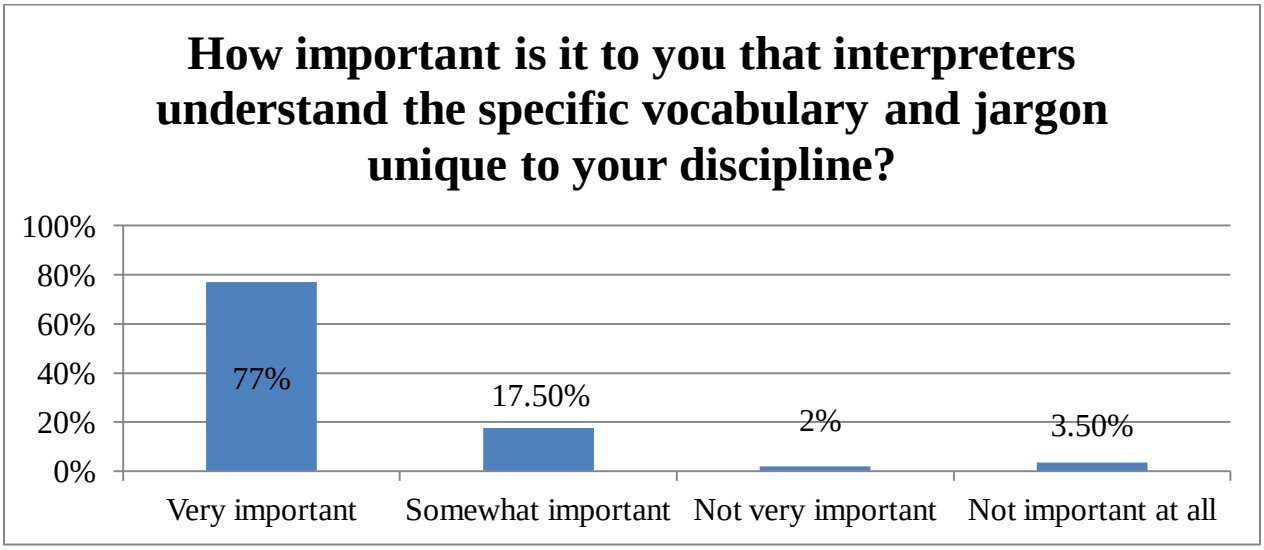
Importance of specific interpreter training in the discipline	Responses
Very important	31
Somewhat important	17
Not very important	4
Not important at all	5

While training for interpreting in the specific discipline is highly valued, respondents indicated that such training is very rare and that training for interpreting in a specific discipline essentially happens on the job. Some of the respondents mentioned having new interpreters to the discipline shadow interpreters who are regular to the discipline in order to gain an understanding of the skills and knowledge necessary to provide services in that discipline.

Understanding the jargon of the discipline

When asked how important it was for interpreters to understand the jargon of their specific discipline 54 respondents or 95% stated that it was very important or somewhat important, 44 and 10 respectively (Figure 17). Many of the comments indicated that familiarity and an understanding of discipline specific jargon was gained on the job for interpreters. Of all the questions on the survey regarding interpreter competencies this question had the highest incidence of very important or somewhat important answers.

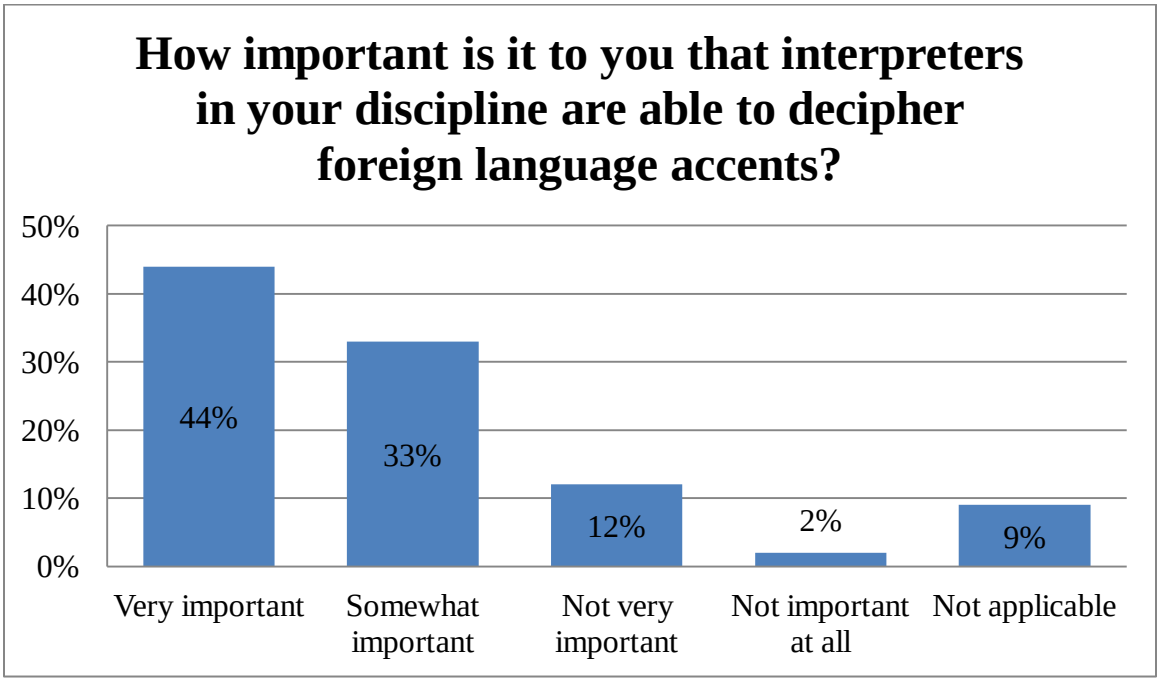
Figure 17. Importance of interpreters understanding the specific jargon of the discipline.



Deciphering foreign accents

Interpreters in the STEM fields are faced with dissecting and processing complicated information and when working with non-native English speakers must be able understand their accents before they can even begin processing the information. When asked about interpreters' ability to decipher foreign accents, 77% of the survey respondents indicated it was either very important or somewhat important for interpreters in their discipline (Figure 18). Only five of the 57 respondents indicated that an interpreter's ability to decipher foreign accents was not applicable in their employment situations, which shows how prevalent non-native English speakers are in the STEM fields.

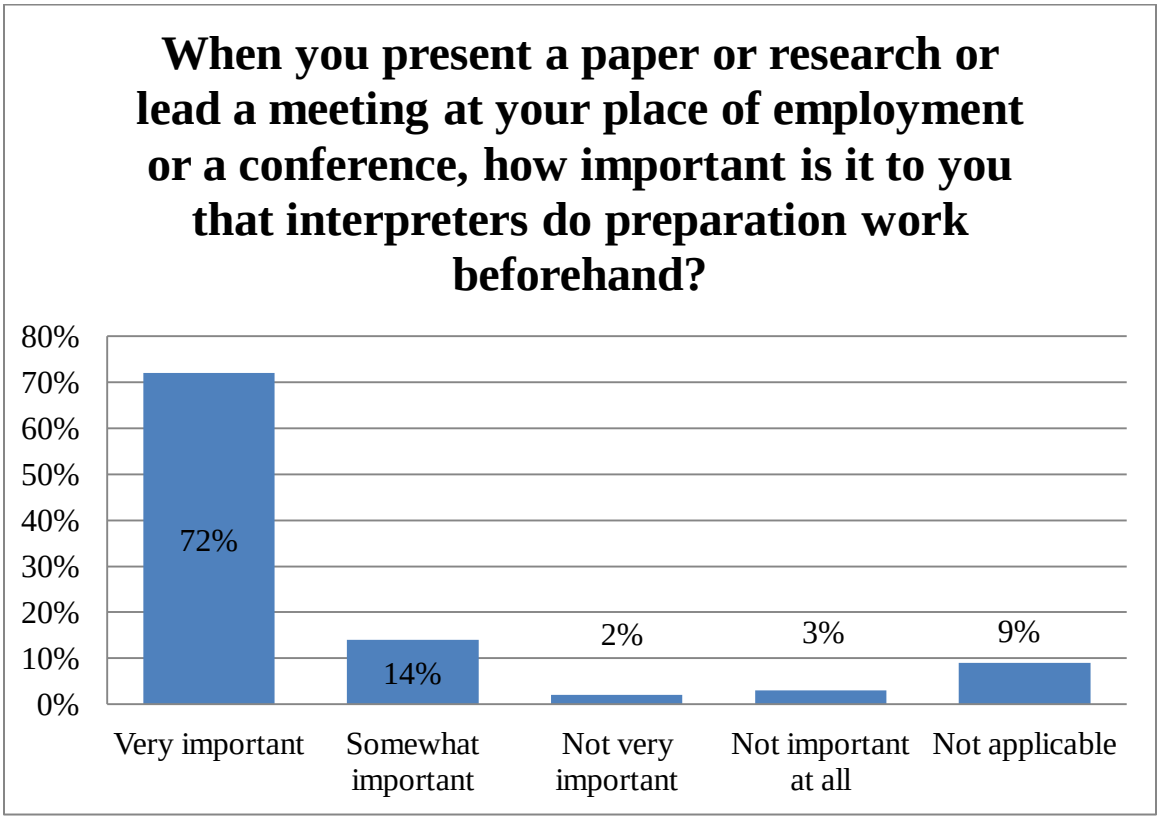
Figure 18. Importance of interpreters being able to decipher foreign accents.



Preparation for presentations

An overwhelming majority of the respondents indicated that interpreters doing preparation work for either their presentations or presentations by hearing colleagues is essential (Figure 19). This was especially true for the Deaf professional's own presentations where interpreters are working from signed language into English. There were a couple of respondents who stated they voiced their own presentations so it was not necessary for interpreters to prepare for their presentations, but they felt it important that interpreters do preparation work for a colleague's presentation, especially if it was an unfamiliar topic.

Figure 19. Importance of interpreter preparation work for presentations.



When asked how they expected interpreters to prepare for their presentations, many indicated that they shared their notes, power point presentations, presentation outlines, and other materials. However, what was most important was to rehearse the presentation beforehand or at least meet to discuss what the presentation would entail. Respondents stated that an interpreter who prepared for their presentation was less likely to stop them or interrupt to ask for clarification of a concept or signed vocabulary; therefore, causing minimal effect on how audience members perceived the Deaf person's knowledge of the subject matter and ability to present the information.

Issues of understanding concepts specific to the discipline

Interpreters may encounter concepts or vocabulary specific to the discipline they do not understand while working in the STEM fields. For both the interpreter and the Deaf consumer this can cause a disruption in the flow of information. Respondents were asked, "**When interpreters in your discipline encounter concepts they do not understand while interpreting, how do you expect them to address the issue**?" From the responses three strategies emerged as being those preferred by Deaf professionals in STEM that interpreters should employ when encountering concepts or vocabulary they do not understand.

- Indicate to the Deaf professional that the interpreter does not understand the specific concept or vocabulary and the Deaf professional will either explain or ask them to continue the best they can.
- Indicate to the Deaf professional that the interpreter does not understand the specific concept or vocabulary and revert to more English like signing and fingerspelling to get as much information across as they can.
- Interrupt the speaker to ask for clarification, but only when appropriate, and to indicate that it is the interpreter who does not understand the material, not the Deaf professional.

On the other hand, as indicated by the responses to this question, if the Deaf professional is the one giving the presentation and the interpreter does not understand, it is vital the interpreter let them know immediately and switch with a team interpreter or get a quick clarification of the concept or signed vocabulary to continue the interpretation. As indicated by the respondents, this situation can be avoided by the use of adequate preparation time with the interpreter(s).

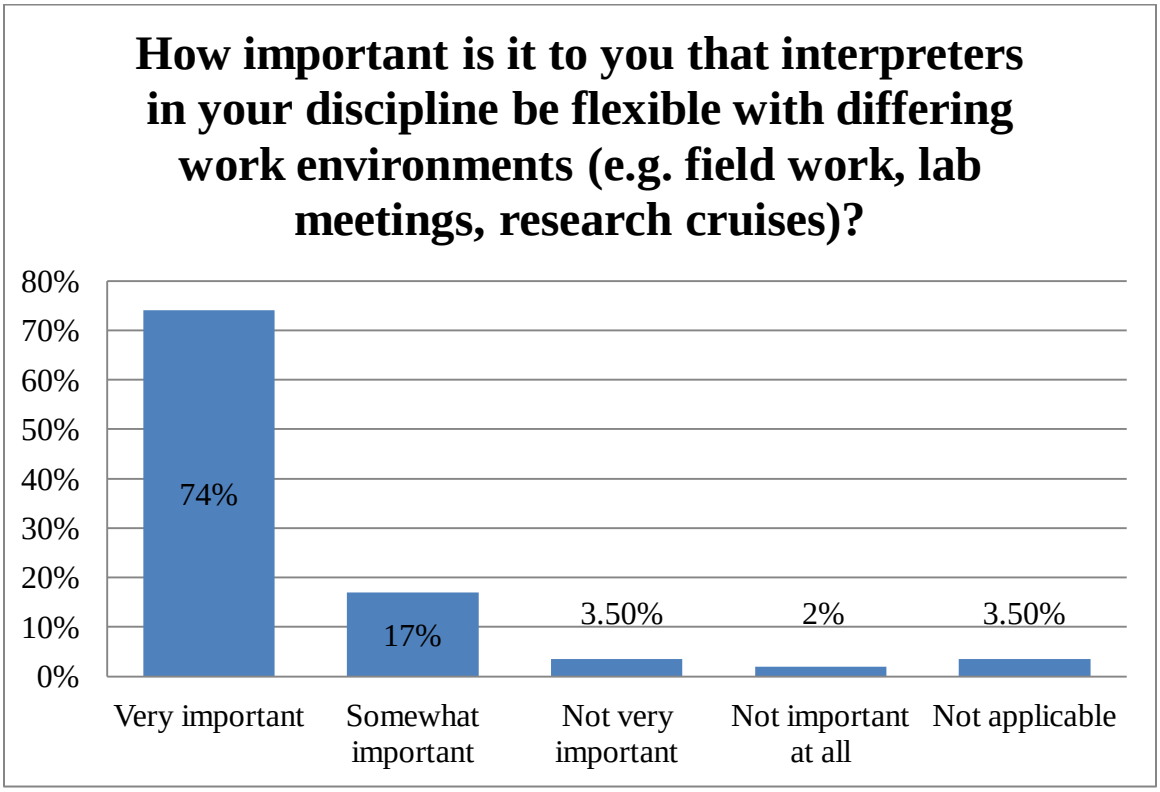
Advocating for interpreter needs

Most respondents felt it essential that the Deaf professional and interpreter work as a team to advocate for any interpreter needs that may arise. However, many indicated that it depended on the specific situation and the identified need. Respondents indicated that interpreters should always let the Deaf professional know their needs and decide how to advocate those needs as a team.

Flexibility in working environments

Lab meetings, presentations, discussions with colleagues and team leaders, social settings, and field work are all part of a Deaf professionals experience in STEM. Interpreters need to be adaptive to this variety of settings in order to provide effective services. With 91% of the survey respondents indicating that an interpreter's flexibility in adapting to a variety of work environments was either very important or somewhat important (Figure 20), this shows flexibility in adapting to differing work environments ranks high in terms of interpreter competencies for providing communication access services in the STEM fields. The remaining 9% of the respondents stated that their work environments varied little as they were mainly in academia and only used interpreting services in the classroom or for departmental meetings.

Figure 20. Interpreter flexibility in adapting to varying work environments.



Other competencies

The last question in the survey asked respondents to identify any additional competencies that had not been mentioned or addressed previously in the survey. Many comments emphasized what has already been mentioned about language flexibility, adapting to changing working environments, working with the Deaf professional to clarify understanding of concepts and discipline specific vocabulary, and an interpreter's content specific knowledge. Those comments have been incorporated into the data analysis of those specific sections of the survey. There were, however, several comments about the professionalism and attitude of interpreters that respondents felt were traits interpreters in STEM should possess.

- “Dress professional!!! Professional etiquette is also important.”
- “I think that attitude is important - love for learning is important!”
- “Professionalism! Be people-savvy: know who's who, when to chat and when to work, define and respect boundaries, negotiate.”
- “Have a GOOD ATTITUDE, be punctual, show initiative, be teachable/humble”
- “Having a "Deaf Heart" - interpreters who are actively involved in the Deaf community and interact with them outside of their work. This is very important quality I look for in an interpreter. When an interpreter has that, s/he tends to have exemplary skills in other aspects of interpreting.”

While these may not necessarily be considered competencies, it is essential for interpreters to know that these traits are identified by Deaf professionals as being an integral part of interpreting in STEM. Finally, one respondent summed up what they expected of interpreters in STEM quite succinctly:

“Curiosity. That's science.”

DISCUSSION

I. Demographics

In order to generalize the data and findings to the larger population of Deaf professionals in the STEM fields, the goal for this exploratory study was a sample size of 100 respondents to the survey instrument. This sample size number was chosen arbitrarily due to the fact that there are no statistics that relate the number of Deaf professionals employed in the STEM fields. Although the actual sample size, based on submission of completed surveys, was 57, the data collected was robust enough to guide a preliminary generalization about the larger population. Respondents added many comments, when provided the opportunity, enriching and clarifying the statistical data garnered directly from the questions asked. During the analysis of the data clear trends were discovered to allow certain conclusions to be made and to address the research questions posed.

a. Fields and disciplines

The survey asked, "**In which STEM field (science, technology, engineering, or mathematics) do you work**?" There were 73 responses to this forced answer question as respondents were allowed to indicate if they worked in more than one field. The majority of respondents, 68%, indicated they worked in the fields of science and technology with the remaining 32% working in engineering and mathematics.

When respondents were asked to identify the specific discipline within the STEM field they indicated in which they were employed, they identified a broad range of disciplines demonstrating that Deaf professionals are pursuing their interests toward careers and

employment in a large variety of areas within the STEM fields. The following is just a snapshot of the disciplines in which respondents indicated they were currently employed: veterinary medicine, mechanical engineering, software engineering, pharmacology, biotechnology, marine biology, data base development, aerospace engineering, astronomy, computer science, neuroscience, biophysics, genetics, industrial engineering, semi conductor physics, and immunology. While this is not an exhaustive list of the disciplines respondents reported, it does show that Deaf people are free to pursue careers of interest across a wide variety of disciplines within the STEM fields. This variety of disciplines also indicates the specificity of subject matter with which interpreters may find themselves working while providing services as well as the specialized knowledge and skills needed to provide those services within the disciplines identified.

b. Geographical representation

There is a fairly even representation of respondents across the U.S. The exceptions are the South and Southwest as the regions with the fewest respondents. The two largest institutions of higher education that cater specifically to Deaf students are located in the Northeast, RIT, and Washington D.C., Gallaudet University. There was a high incidence among those respondents who indicated they were located in these areas to also indicate they were employed in the academic sector. For those who reported being located in the West Coast area, there were many who also indicated they worked in technology and engineering, reflecting that regions propensity to be the technology center of the U.S.

II. Interpreting Services

Respondents were asked to share their experiences using interpreting services in their STEM field. The questions asked were designed to provide information that allows a general picture of the interpreting experience in STEM to emerge. This section of the survey was also used to collect data relative to the research question, "Are there enough qualified interpreters to provide effective communication access services in the STEM fields?"

a. Situations where interpreters are used

Respondents reported a wide variety of situations where they utilize interpreting services, from group meetings to direct patient care to classroom presentations. The data indicates the wide variety of settings and situations within the STEM fields in which interpreters must be prepared to provide services. On any one assignment interpreters may be required to provide services in several different settings and situations. For example, the interpreter may provide services in a lab meeting, a one-on-one meeting with a colleague to discuss next steps on a research project, a presentation by a colleague on their findings, and finally, phone calls to other colleagues working on similar projects in other labs. According to the Deaf professionals who responded to the survey, the ability of interpreters to adapt to differing work environments is highly valued. Of the 57 respondents, 52, or 91%, indicated that interpreter flexibility in adapting to differing environments was somewhat important to very important, with the majority, 42, or 74%, indicating that interpreter flexibility in adapting to differing environments was very important (see Figure 20).

b. Designated interpreters

With over 50% of respondents using designated interpreters across all STEM fields and employment sectors, the importance of using consistent service providers becomes apparent. Many interpreters who provide services in the STEM fields get their "training" on the job. The responsibility of training of interpreters for specific disciplines falls primarily on the Deaf professional. This is a responsibility above and beyond the Deaf professional's regular job tasks and can be time consuming and challenging. The number of designated interpreters indicates that once the Deaf professional has trained an interpreter or small group of interpreters to their specific discipline they use those same interpreters consistently in order to avoid spending the time and energy on training new interpreters every time they are requested for an assignment.

When analyzed by reported employment sector, the data again shows the common use of designated interpreters, this holds especially true in the academic and public sectors. Still, with 55% or more reporting the use of designated interpreters across all sectors of employment the trend to use consistent services is, again, obvious. In addition to the possible reason stated above, the high frequency in the usage of designated interpreters in the academic and public sectors could be a result of entities hiring interpreters into full or part time staff positions. Interpreters in staff positions would be more readily available to provide consistent services to Deaf professionals in all employment sectors due to the fact that both work for the same entity and the same interpreter or team of interpreters can be assigned regularly to the same Deaf professional when requested. Interpreters who work as independent contractors, by contrast, may not be able to provide on-going and consistent services to the same Deaf professional on a regular basis due to their varying availability and commitment to other assignments.

c. Difficulties of securing interpreters

The number one reason cited for having difficulties securing interpreters for any given assignment was a lack of qualified interpreters available. Respondents indicated there is an inadequate supply of interpreters in their geographical areas qualified to provide services in their specific discipline. This barrier to securing services was reported equally across employment sector and STEM field. The possible reasons for the reported lack of qualified interpreters are addressed in the following section (*Supply of qualified interpreters*).

Another reason cited for having difficulties securing interpreting services was the unavailability of interpreters for last minute or late notice requests. Most interpreters' schedules fill up quickly due to the high demand for services; therefore, when interpreters are requested with short notice, they are unavailable. If there is already a lack of qualified interpreters to provide services in the STEM fields, the situation is compounded by those who are qualified, but not available due to full schedules. The situation of interpreters not being available for short notice requests can be alleviated in larger institutions by hiring interpreters into full or part time staff positions. If there is a pool of interpreters on-site when last minute requests for services are made, schedules can be adjusted or rearranged to accommodate the request. Lack of qualified interpreters implies that Deaf professionals in the STEM fields must make it known to their employers that there is such a lack and that short notice requests compound the situation and make it almost impossible to secure services. Employers then need to consider this situation when scheduling activities and events, such as meetings, presentations, and trainings.

d. Supply of qualified interpreters

Over half of the survey respondents indicated that there are not enough interpreters qualified to provide effective communication access services in the STEM fields. This finding corroborates Cooke & Graham (2012) who reported Deaf professionals in the STEM fields feeling frustrated and being excluded from employment events due to a lack of qualified interpreters. As reported by survey respondents, there are a number of reasons for the lack of qualified interpreters including: a general shortage of interpreters in certain geographical areas, lack of STEM specific training for interpreters, and interpreters not accepting assignments they do not feel qualified to interpret. These reasons have also been indicated in legal and healthcare settings. Roberson et.al. (2012) report that the main reason the interpreters they surveyed did not provide services in legal settings was due to lack of training in that realm. Walker and Shaw (2011) also indicate that lack of specific training prevented interpreters from accepting assignments in mental health, medical, and legal settings as well as working with Deaf-Blind persons. Results of all these studies must be considered by the interpreting profession as well as the profession of interpreter education. Also, as reported in the demographic data, the requirement that interpreters possess specialized knowledge and skills while providing services within the STEM fields and disciplines may be a factor that has led to the indicated lack of qualified interpreters to provide services. If interpreters are not taking assignments they do not feel adequately prepared for there is a need to provide field and discipline specific training so that Deaf people can enjoy their right to communication access in all aspects of their lives.

Lack of qualified interpreters is the top obstacle Deaf professionals in the STEM fields report in regard to securing interpreting services. While all Deaf individuals in the U.S. are afforded the right to communication access services under federal mandates (either the ADA or

the Rehabilitation Act of 1973 Section 504), exercising this right becomes all but impossible if there are not enough qualified interpreters. If Deaf professionals in the STEM fields are unable to secure interpreting services they are forced to use alternative strategies for communication with others or be left out of the discourse event altogether. According to the survey responses, Deaf professionals may choose to use written forms of communication at their place of employment, either hand written notes or the use of technology such as email and instant messaging. Others may rely on speech reading and speech to communicate when interpreters cannot be secured for assignments. Whatever alternate method of communication Deaf professionals in the STEM fields may choose to use when interpreters are not available may add a burden and certain amount of frustration to their employment situation. These alternative means of communication may not be ideal depending on the communication event itself. Lack of qualified interpreters to provide communication access services in the STEM fields may cause an undue hardship and additional work related stress on the part of the Deaf professional.

It is incumbent on the interpreting and the interpreter education professions to recognize the lack of qualified interpreters to provide services in the STEM fields and take steps to remedy the situation. While in the U.S. Deaf professionals enjoy the right to communication access services, these rights cannot be exercised if the field of signed language interpreting is not prepared to provide appropriate and qualified services. The lack of qualified interpreters for STEM related assignments may serve to impede the progress and advancement of Deaf professionals as well as Deaf students seeking education and future careers in STEM fields.

III. Video Relay Services and Video Remote Interpreting

Participants in this study were asked about their use of VRS and VRI services to determine if either or both services were used as an alternative to in-person interpreter service provision. While VRI services are a fairly new option, use of such services could help alleviate the reported shortage of qualified interpreters by tapping into larger pools of interpreters remote to the assignment location.

a. Use of VRS

While 61% of the respondents reported using VRS to conduct work related business, only 58% of those are satisfied with the interpreting services they receive. The preferred method of conducting work related business was through email or instant messaging. Each VRS provider has their own protocol for hiring interpreters including possession of credentials and interpreting experience. Deaf professionals making STEM related calls are subject to the interpreting services they receive when first placing the call to the VRS provider. The interpreters who answer the call may or may not have knowledge of, experience in, or a skill set conducive to the callers' discipline or the subject matter of the call. If Deaf professionals in the STEM fields are allowed to request interpreters who have experience in their field or discipline and the VRS provider was able to honor that request, satisfaction with the use of VRS would probably increase. Requesting interpreters who are qualified in STEM interpreting while using VRS could give Deaf professionals another means to alleviate the barriers faced by not having enough qualified interpreters to provide services on-site.

b. Use of Video Remote Interpreting Services

The use of VRI services is a fairly new phenomenon that is only now gaining popularity in certain situations, such as healthcare and legal settings. Only seven of the respondents to the survey reported using VRI services to conduct work related business. As the technology of providing VRI services improves with better internet streaming speeds and video clarity, VRI may become another option for Deaf professionals in the STEM fields to use in order to overcome the barrier posed by the lack of qualified interpreters in STEM. Deaf professionals would have the option of securing interpreting services outside of their geographical area where there may be a larger pool of STEM qualified interpreters.

IV. Interpreter Competencies

Respondents to the survey were asked to rank how important they felt certain competencies were for interpreters in STEM to possess. They were also given the option to submit additional comments regarding these competencies which helped to further clarify why they thought identified competencies were important, or not, for interpreters to have.

a. Credentials

As there are several different credentials that interpreters in the U.S. and Canada may or may not possess through different credentialing entities, it is not surprising that credentials are not ranked high among Deaf professionals in the STEM fields as a way of measuring interpreters' abilities to provide services. However, requiring specialty credentials (e.g., certification) for interpreters who are qualified to provide services in the STEM fields may assist

Deaf professionals in securing appropriate service providers. RID and the Texas BEI are currently the only interpreter credentialing bodies that provide specialty certifications for interpreters who provide services in legal settings: Specialty Certification: Legal and Court Certification respectively (RID, 2006; DARS/BEI, 2014). The Texas BEI is currently in the beginning phases of developing another specialty certification for interpreters who provide services in healthcare settings. These credentials ensure that interpreters who have achieved the specialty certification meet the minimum established requirements, standards, and skill level necessary for providing services in these specialty areas. If such specialty credentials were available for interpreters in the STEM fields, Deaf professionals would have an additional means to identify qualified interpreters to provide services.

b. Flexibility in signing

In the U.S. and Canada there are a variety of Manual Codes of English that are used by some Deaf people depending on several factors, including educational background and personal preference. As the name suggests, these are systems that have been developed to visually show the English language manually. ASL is the language of the Deaf community in the U.S. and Canada and does not conform to the same linguistic rules of English (see, for example, Baker & Cokely, 1980; Klima & Bellugi, 1979; Lucas, Valli, Mulrooney, & Villanueva, 2011; and Stokoe, 1965). As the data indicates, many Deaf professionals in the STEM fields use a combination of ASL and English like signing. Furthermore, interpreters should be knowledgeable and trained in both ASL and English based signing in order to provide services using the variation preferred by the Deaf consumer. Several of the respondents to the survey indicated a preference for interpreters to use English based signing (also known as transliteration) while providing services for the professional's specific job task with a preference

for interpreters to use ASL (interpreting) in more casual job settings. Thus, an interpreter's ability to use a range of ASL to English-like signing while providing services in the STEM fields becomes important. Seventy-eight percent of the respondents to the survey indicated this competency was very important or somewhat important for interpreters in the STEM fields to possess. Not having the flexibility to use a range of signing from English to ASL during service provision results in the interpreter being unable to provide services in the consumer's preferred language or language variation. Consumers would then have to reinterpret the information into their preferred language variation or miss information altogether.

c. Knowledge of the discipline

The data shows that Deaf professionals in the STEM fields prefer interpreters to have some degree of content knowledge in the disciplines in which they interpret. Interpreting is essentially an act of transferring meaning in one language to another language and, in the case of signed language interpreting, to another modality. Understanding the meaning behind a communication event is essential for interpreters to provide a dynamically equivalent message in the target language. If one does not understand a message in one language it is impossible to re-create that same message in another language. Interpreters who provide services in the STEM fields should have some content knowledge of the subject matter within which they are working. This does not mean that interpreters must be content knowledge experts within the disciplines where they provide services in the STEM fields. Such a requirement would exclude the majority of interpreters from providing services in the STEM fields. Instead, interpreters should be hired to do preparation work before providing services on specific assignments. Preparation work may include studying written materials on the subject matter, using audio/visual materials to learn

about the subject matter, or asking the Deaf professional the best way to prepare for the assignment.

Interpreters who provide services in the STEM fields also gain much knowledge on the job. Deaf professionals do not expect interpreters to come into their discipline and provide services already having a deep understanding of the content matter. Deaf professionals in the STEM fields expect interpreters to do any necessary preparation work for the assignment and be willing to accept some degree of training in the discipline by the professional while on the assignment. This on the job training by the Deaf professional can entail explanation of discipline specific vocabulary and concepts, teaching of signs used for discipline specific vocabulary and concepts, and suggestions for materials to study outside of the assignment. As long as interpreters are willing to do some amount of preparation work for the STEM assignment and accept on the job training by the Deaf professional they can gain the content knowledge necessary to provide interpreting services in the specific discipline.

Another way for interpreters to gain the content knowledge necessary to provide dynamically equivalent services in STEM fields is to work regularly in the same discipline. As previously shown, many Deaf professionals in the STEM fields use the services of designated interpreters. As a designated interpreter one has the opportunity to become knowledgeable about the content within the discipline which, in turn, reduces the burden placed on the Deaf professional of having to train each different interpreter who comes to the assignment. Designated interpreters not only provide consistency in services to all parties involved, they can also serve as mentors for interpreters who want to become knowledgeable and learn the skills necessary to provide services in the STEM fields.

d. Prior experience interpreting in the discipline

The majority of Deaf professionals in the STEM fields also prefer interpreters to have some amount of prior experience providing services in their specific discipline. However, respondents to the survey who indicated a preference for interpreters with prior experience also acknowledged the fact that it is rare to find interpreters with prior experience in their specific discipline. Again, many respondents stated they provided on the job training to interpreters in their specific discipline to account for the interpreter's lack of previous experience. As mentioned in the previous section, the use of designated interpreters alleviates the need for Deaf professionals in the STEM fields to train each different interpreter who is providing services for any given assignment. The Deaf professionals' preference for using the services of an interpreter with prior experience in their discipline may be yet another reason why designated interpreters are prevalent in the STEM fields.

e. Interpreter education and training

Nearly half of the respondents to the survey indicated they preferred interpreters who provide services in their discipline to have at least a four year degree, but not necessarily in the Deaf professionals' field. Having at least a four year degree may guarantee that an interpreter has a certain amount of generalized knowledge in a variety of topics. In fact, RID requires that candidates wishing to take the interpreter certification test must possess a four year degree or provide proof they have the equivalent experience that amounts to a degree (RID, 2014). The Texas BEI requires candidates for certification to possess a two year degree (DARS/BEI, 2014). Interpreters who held certification prior to the adoption of these requirements are exempt from this mandate unless they wish to take the certification test again. While Deaf professionals in the

STEM fields who responded to the survey did not rank certification high as a means to measure an interpreters skill level, the degree requirements placed on candidates for certification by these two testing entities practically ensures that interpreters will have the generalized knowledge afforded by holding a degree.

Aside from holding an official degree, Deaf professionals in the STEM fields overwhelmingly prefer that interpreters have some type of training for interpreting in the discipline in which they are providing services. Respondents also acknowledged the fact that training for interpreters in specific STEM disciplines is very rare and such training almost always happens on the job. Having interpreters experienced in providing services in the STEM fields act as mentors to other interpreters who wish to develop the knowledge base and skills necessary to provide services in such fields is one way of providing discipline specific training. Providing this type of mentorship/training would serve to increase the pool of interpreters qualified to provide services in the STEM fields which would help to alleviate the reported lack of interpreters who are able to provide such discipline specific services.

f. Understanding the jargon of the discipline

Each discipline within the STEM fields has its' own unique vocabulary and jargon specific to that discipline. For those not experienced or versed in the specific discipline, understanding and making sense of the vocabulary and jargon used can be quite challenging. Interpreters need to be able to understand the vocabulary and jargon specific to the discipline in order to decipher its' meaning and provide an accurate interpretation of that meaning. For Deaf professionals in the STEM fields, an interpreter's ability to understand the vocabulary and jargon used in the specific discipline was ranked the highest of importance among the identified

competencies. Not only do Deaf professionals feel this way, interpreters who provide services in STEM rank understanding of discipline specific jargon as one of the biggest challenges to providing effective services in those disciplines (Grooms, Cargill, Dutton, & Graham, 2012). In the current study only three of the respondents indicated that it was not very important or not important at all for an interpreter to understand the vocabulary and jargon of their discipline. Those who indicated that the understanding of jargon was an important competency for interpreters to possess also indicated that an understanding of the discipline specific jargon was mostly gained on the job by interpreters. This is yet another argument for the use of designated interpreters in the STEM fields as those who provide ongoing and consistent services in one or more specific discipline are able to assimilate and retain the meaning of the discipline specific vocabulary and jargon. On subsequent assignments in the same discipline designated interpreters are able to readily understand the vocabulary and jargon and render a meaningful and equivalent interpretation in the target language.

Respondents to the survey indicated that the ability of the interpreter to use the discipline specific vocabulary and jargon was especially important when the Deaf professional was giving a presentation. An interpreter who is not familiar with discipline specific vocabulary and jargon in this situation could skew an interpretation and cause the Deaf professional to seem unprepared or unqualified to give the presentation. In turn, an interpreter who is providing skewed or even incorrect interpretations can have a detrimental effect on the reputation of the Deaf professional or even jeopardize the professional's employment situation. Interpreters who provide services in the STEM fields must be aware of the impact of not understanding the vocabulary and jargon of the discipline on all parties involved in the communication event.

For those interpreters who provide services in the STEM fields simply keeping a written or video log of discipline specific vocabulary and jargon encountered during each assignment may assist in retaining the meaning for subsequent assignments. Sharing this running log with the Deaf professional to ensure accuracy also provides that professional with a tool for training interpreters new to providing services in the discipline. This strategy is beneficial to both interpreters and Deaf professionals and fosters a sense of teamwork toward providing appropriate and accurate interpretation services. As Deaf professionals in the STEM fields highly value the interpreter's ability to understand the vocabulary and jargon specific to the discipline, it is incumbent on the interpreter providing services to use all means necessary to become familiar with the terms used.

g. Deciphering foreign accents

Interpreters who provide services in the STEM fields are faced with many challenges. Among these challenges is the ability to decipher the accents of non-native English speakers who Deaf professionals communicate with in their discipline. If interpreters are unable to understand the accents of non-native English speakers the information they are trying to convey becomes inaccessible and renders an interpretation impossible. The Deaf professionals who responded to the survey ranked the ability of interpreters to decipher foreign accents very high among the competencies that interpreters in the STEM fields should possess. One way for interpreters to develop this ability is to consistently provide services in the same setting with the same participants. Interpreters who do this not only gain a deeper understanding of the vocabulary and jargon used, but they also become familiar with how non-native English speakers pronounce the discipline specific vocabulary and jargon. Correctly deciphering these accents allows the interpreter access to the information being communicated leading to an accurate interpretation.

The ability to decipher and understand the accents of non-native English speakers becomes extremely beneficial for interpreters who provide services at international STEM conferences where researchers, scientists, and professionals from around the globe gather to exchange information. While English may be the official language of these conferences the participants may not be native speakers and their accents may be quite pronounced. Interpreters must be able to decipher these accents in order to gain access to the information to be interpreted. An inability to understand the information being communicated due to a non-native English accent prevents the interpreter from providing access to the information for the Deaf professional for whom they are providing services. In situations where interpreters are working in a team with another interpreter or interpreters, those who are in the support role can assist the working interpreter with deciphering non-native English accents and gaining access to the information in order to render an interpretation and provide access to the communication event.

Based on the researcher's own experience of providing services in the STEM fields, encountering the accents of non-native English speakers is quite common. In fact, for this study only five of the respondents to the survey indicated that an interpreter's ability to decipher foreign accents was not applicable in their discipline. Having so few respond in this manner is a clear indication of the prevalence of non-native English speakers in the STEM fields.

h. Preparation for presentations

Engaging in some form of preparation work before any assignment is one strategy that may make the work of an interpreter more effective and less demanding. This is especially true in the STEM fields where interpreters, more often than not, do not hold the same degree of knowledge in the discipline as the participants in the communication event. The Deaf

professionals who responded to the survey indicated that preparation work for interpreters was essential whether the presentation was given by the Deaf professional themselves or their hearing colleagues.

Preparation work can take many forms. Reading a research paper or article that will be presented and discussed is one way for interpreters to understand the work that is being shared and a way to become familiar with the vocabulary that will be used for the presentation. Studying a presenter's PowerPoint slides and/or presentation outline is another way for interpreters to become familiar with the information being presented. Deaf professionals in the STEM fields rely on an interpreter's willingness and ability to rehearse a presentation beforehand when it is given by the Deaf professional. An interpreter who is not prepared to interpret a presentation given by the Deaf professional may find themselves having to stop the presenter to ask for clarification of a concept or signed vocabulary or may misinterpret the information altogether. In turn, this can have a detrimental effect on how the audience views the Deaf professional and their presentation. Being able to rehearse a presentation with the Deaf professional beforehand reduces misunderstandings, miscues, and inaccurate interpretations.

i. Issues of understanding concepts specific to the discipline

While providing services in the STEM fields interpreters may encounter concepts or vocabulary specific to the discipline they do not understand causing a disruption in the flow of the communication event. The Deaf professionals who responded to the survey indicated that it is of vital importance that interpreters inform them when they encounter concepts and vocabulary that they do not understand. Not doing so may lead to an inaccurate interpretation of the material which could have an adverse effect on the Deaf professional depending on the

situation. Interpreters must be willing and able to admit when they do not understand the information in the communication event and develop strategies to quickly gain an understanding of the material in order to render an accurate interpretation.

j. Advocating for interpreter needs

Interpreters who provide services in the STEM fields may encounter logistical challenges that need to be overcome in order to provide fully accessible communication access services. These challenges can include poor lighting, barriers to sight lines with the Deaf consumer, limited space in the environment, and uncomfortable working conditions. The survey respondents indicated that it is essential for interpreters to make their needs known to the Deaf professional with whom they are working. The Deaf professional and the interpreter may then work as a team to decide how to advocate for the needs of the interpreter depending on the situation and setting. The settings in which interpreters in the STEM fields find themselves working may be quite varied and may include obstacles that are not conducive to providing full communication access to the event.

k. Flexibility in working environments

As stated above, interpreters who provide services in the STEM fields may find themselves in a wide variety of working environments. The ability of interpreters to adapt to these differing environments is valued very highly amongst Deaf professionals in the STEM fields. The ability for interpreters to adapt to changing work environments becomes especially important when providing services for field work. Interpreters may need to wear special clothes or gear in some instances. They may find themselves providing services in extreme environments where it is cold, hot, dark, and/or wet. Interpreters must be able to adapt to these special

environments and work with the Deaf professional to address any logistical challenges that arise. Interpreters must also be cognizant of any safety issues that present themselves depending on the environment in which they are providing services and conform to any safety protocols. Interpreters may find themselves donning bio-hazard suits, surgical masks, hard hats, or even gloves on certain assignments. Interpreters must be prepared and flexible in adapting to these unique situations if they are to provide effective services in the STEM fields.

l. Other competencies

Many of the Deaf professionals who responded to the survey mentioned the fact the interpreters in the STEM fields must be professional and have a good attitude. Unfortunately, the survey was not designed to ask what was meant by being professional and having a good attitude. Being professional could entail showing up promptly for assignments, wearing appropriate attire for the situation, engaging in preparation work, or supporting interpreters who are new to providing services in the STEM fields. Having a good attitude could mean showing a willingness to work with the Deaf professional to do preparation work or solve logistical issues, working without complaint when the information is tough to decipher, or simply showing respect to all parties involved in the communication event. Without the ability to ask the respondents to further define what they mean by interpreters being professional and having a good attitude, it is impossible to determine how these two traits translate into competencies.

For interpreters who provide services in the STEM fields and for those who would like to provide services in these fields, the fact that the Deaf professionals who responded to the survey mentioned professionalism and a good attitude is important. For the respondents to mention these traits, they must have encountered interpreters who they determined were not professional and

did not possess what they perceived was a good attitude. Just the fact that these two traits were mentioned often shows the impact interpreters have on the communication event and the participants in that event. It is incumbent on interpreters and Deaf professionals in the STEM fields to discuss and clarify what constitutes an interpreter who is professional and has a good attitude. A mutual understanding of these two traits will lead to a more robust definition of what constitutes competencies that interpreters in the STEM fields must possess in order to provide competent services in those fields.

The rankings of these competencies, and additional comments provided by respondents to the survey, have resulted in a consolidated list of nine specific competencies that Deaf professionals have identified that interpreters should possess in order to provide effective communication access services in the STEM fields and disciplines. The results of this study should be used to further explore how interpreters develop the identified competencies and how the field of signed language interpreting and interpreter education can prepare practitioners and students of interpreting to provide effective services in the STEM fields and their associated disciplines.

CONCLUSION

The overarching purpose of this exploratory research was to ascertain what competencies signed language interpreters must possess in order to provide accurate and reliable communication access services for Deaf professionals in the STEM fields. For the purposes of this study competencies are defined as the knowledge base, skill set, and abilities an interpreter engages during any given STEM assignment. In order to identify these competencies, Deaf professionals in the STEM fields were asked to complete a survey based on their experience utilizing interpreting services. The survey asked respondents to identify by ranking the importance of specific competencies they felt interpreters should possess in order to provide reliable and accurate services in their field and discipline. Competencies were deemed to be significant if 51% or more of the respondents identified them as being at least somewhat important. Based on the results of this study the following nine competencies were identified by Deaf professionals in the STEM fields as being ones that interpreters who provide services in these fields should possess.

1) ***Flexibility in signing***

   Interpreters possess the ability to use a range of signing varieties from American Sign Language to English-based signing depending on the consumers' language preference for any given situation.

2) ***Knowledge of the field and discipline***

Interpreters possess basic knowledge of the STEM field and discipline in which they are providing services.

3) ***Prior experience interpreting in the field and discipline***

Whenever possible interpreters possess prior experience providing services in the STEM field and discipline in which they are providing services.

4) ***Interpreter education and training***

Interpreters possess a general education background and pursue training to enhance the services they provide in the STEM field and discipline in which they are providing services.

5) ***Understanding the jargon of the field and discipline***

Interpreters possess an understanding of the vocabulary and jargon used in the specific STEM field and discipline in which they are providing services.

6) ***Deciphering foreign accents***

Interpreters possess the ability to decipher the accents of non-native English speakers in the STEM field and discipline in which they are providing services.

7) ***Flexibility in working environments***

Interpreters possess the flexibility and willingness to provide services in a wide variety of working environments in the STEM field and discipline in which they are providing services.

8) ***Preparation for assignments***

Interpreters possess the willingness and ability to engage in preparation work for interpreting in the STEM field and discipline in which they are providing services.

9) ***Collaboration with consumers***

Interpreters possess the willingness and ability to work in collaboration with consumers in the STEM field and discipline in which they are providing services to gain an understanding of concepts specific to that field and discipline and to advocate for any logistical needs that may arise.

The second purpose of this study was to document whether Deaf professionals in the STEM fields felt there were enough interpreters to provide appropriate and adequate communication access services in those fields and disciplines. The lack of qualified interpreters to provide services in the STEM fields and disciplines was determined to be significant if 51% or more of the respondents indicated that such a shortage of interpreters existed. In this study 56% of the respondents indicated a lack of qualified interpreters in the STEM fields and disciplines. While Cooke & Graham (2012) report that Deaf professionals in STEM experience frustrations due to the lack of qualified interpreters able to provide communication access services, this study documents the fact that the majority of Deaf professionals in STEM directly report a lack of qualified interpreters able to provide effective services in their chosen fields and disciplines.

Understanding what Deaf professionals define as competencies that interpreters should possess in order to provide appropriate and adequate services in the STEM fields and disciplines is the first step in addressing the lack of interpreters qualified to provide services. With identified and agreed upon competencies interpreter practitioners and interpreting students have a foundation on which to build their skill set and knowledge base towards providing services in the STEM fields and disciplines. In addition, interpreter educators have a base with which to develop curriculum specific to training interpreters toward competence in providing services in the STEM fields and disciplines. Training and educating interpreters toward these competencies will serve to increase the pool of interpreters qualified to provide services in the STEM fields and disciplines which will, in turn, alleviate the frustrations and limitations that Deaf professionals experience due to the lack of qualified interpreters.

RECOMMENDATIONS

While this study was successful in identifying the competencies that signed language interpreters should posses in order to provide effective communication access services in the STEM fields, it is scratching the surface of understanding what interpreting in the STEM fields entails. Based on the analysis of the findings in this study and the conclusions noted, the following recommendations for further research are offered:

1. Conduct focus groups and/or interviews with Deaf professionals in the STEM fields regarding their opinions on the identified competencies from this study and to explore what is meant by interpreters in STEM being professional and having an appropriate attitude. Doing so will help to further define the identified competencies and identify other attributes that Deaf professionals feel interpreters should possess before interpreting in the STEM fields.
2. Conduct a comparison study with interpreters who identify as providing services in the STEM fields in order to ascertain what competencies they believe interpreters should possess to provide effective services. Such a study would, hopefully, confirm the competencies identified in this research by Deaf professionals in STEM. This study should include a section on how interpreters received training and gained the competencies necessary to provide effective services and the challenges faced by interpreters in the STEM fields. This type of information would serve to further an understanding of how interpreters become qualified to provide services in the STEM fields and how they handle the work they are faced with when providing services.

3. Conduct a study of Interpreter Preparation Programs to discover and document what, if any, curriculum they offer to interpreting students who wish to pursue service provision in the STEM fields.
4. Encourage the RID and Texas BEI, as interpreter certification bodies, to explore the need for and possibility of providing specialist credentials through a testing system that will identify the bearer as having the minimum competencies necessary to provide interpreting services in the STEM fields.
5. Encourage Deaf professionals and interpreters in the STEM fields to collaborate on developing workshops and trainings and offer such trainings to interpreters who wish to gain the competencies necessary to provide services in STEM. More opportunities for STEM interpreter training will serve to increase the pool of interpreters qualified to provide effective services.

A more thorough understanding of what providing effective interpreting services in the STEM fields entails will allow the profession of interpreting and interpreter education to move towards providing the necessary training and mentoring needed to increase the number of interpreters qualified to provide services. Without the barriers that a lack of qualified interpreters presents, Deaf professionals in the STEM fields and disciplines will be able to participate fully in the information exchange and activities necessary to advance their careers. Full access to communication is a Deaf persons right in all aspects of life and the interpreting profession must be able to support and provide appropriate and adequate services that allow that right to be exercised.

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APPENDIX A

Consent

My name is Christopher Grooms and I am a graduate student at Western Oregon University in the College of Education seeking my Master of Arts Degree in Interpreting Studies under the supervision of Dr. Elisa Maroney. I am conducting a research study entitled *Interpreter Competencies in Science, Technology, Engineering and Mathematics as Identified by Deaf Professionals* which seeks to ascertain what Deaf professionals in the STEM fields define as competencies that interpreters must possess in order to provide effective communication access services in those fields.

I am seeking Deaf professionals who work in the STEM professions to participate in this study by completing a survey that can be found at [SurveyMonkey Link]. The survey will take approximately 15-20 minutes of your time. Your participation is voluntary and you can discontinue the survey at any time if you so choose. All participants will be anonymous and there is no foreseeable risk or discomforts to your participation. Participation in the survey will serve as your consent. You must be 18 years or older to participate in this study.

The results of this study will be used in my master's thesis, and may be used in reports, presentations, or publications. Once completed and approved my thesis will be published on Digital Commons at wou.edu.

If you have any questions concerning the research study, or wish to receive my completed thesis, please contact me via email at cgrooms13@wou.edu. My graduate advisor, Dr. Elisa Maroney can be contacted via email at maronee@wou.edu. This study has been reviewed

and approved by the Western Oregon University Institutional Review Board (IRB). If you have questions/concerns regarding your treatment as a participant, you may contact the Chair of the WOU IRB via e-mail at irb@wou.edu.

Thank you in advance for your participation,

Christopher Grooms

Master of Arts in Interpreting Studies student, College of Education

Western Oregon University

APPENDIX B

Survey

1. In what STEM field to you work?

Science (including medicine and health services)

Technology (including computer and information technology)

Engineering

Mathematics

2. What is your specific discipline (e.g., astronomy, electrical engineering, biophysics)?

3. In what sector do you work?

Academia

Private sector

Public sector (including government)

Other (please specify)

4. What is your age range?

18-30

31-40

41-50

51-60

Above 61

5. During a typical work week, how often do you use interpreting services?

Less than 1 hour

1-5 hours

6-10 hours

11-15 hours

16-20 hours

21-25 hours

26-30 hours

31-35 hours

36-40 hours

More than 40 hours

6. Please list the situations in which you use interpreting services at your place of employment.

7. Do you work with a designated interpreter or a group of designated interpreters (designated interpreters are those who work consistently with the same Deaf professional in a specific field over a long period of time)?

Yes

No

Other (please specify)

8. Does the person who coordinates interpreting services at your place of employment know your preferred interpreters?

Yes

No

I coordinate my own interpreter services

Other (please specify)

9. What is the most difficult aspect for you in getting interpreting services at your place of employment?

10. Are you able to get your preferred interpreter(s) for international conferences you attend?

Yes

No

n/a

11. Are you able to get your preferred interpreter(s) for domestic conferences you attend?

Yes

No

n/a

12. If applicable, what is the most difficult aspect for you in getting interpreting services for domestic or international conferences?

13. In what geographical area do you work?

U.S. (please specify region or state)

Canada (please specify region or province)

Other (please specify)

14. Do you feel there are enough interpreters in your area to provide quality services in your specific discipline?

Yes

No

Plus comment box

Other (please specify)

15. Do you use Video Remote Interpreting (VRI) services in your place of employment?

Yes

No

Other (please specify)

16. If yes, are you generally satisfied with the services you receive via VRI? Please explain.

Yes

No

n/a

Other (please specify)

Plus comment box

17. Do you use Video Relay Services at your place of employment to conduct work related calls?

Yes

No

Other (please specify)

18. If yes, are you generally satisfied with the services you receive via VRS? Please explain.

Yes

No

n/a

Other (please specify)

Plus comment box

19. What credentials do you prefer interpreters in your discipline to have?

Registry of Interpreters for the Deaf Certification

National Association of the Deaf Certification

Board for Evaluation of Interpreters Certification

Educational Interpreter Performance Assessment Credentials

Certification does not matter

20. How important is it to you that interpreters in your discipline are flexible interpreting in a range from signed English to ASL?

Very important

Somewhat important

Not very important

Not important at all

21. How knowledgeable do you prefer interpreters to be in your discipline?

Very knowledgeable

Somewhat knowledgeable

Not very knowledgeable

No knowledge at all

22. How important is it to you that interpreters have prior experience interpreting in your specific discipline?

Very important

Somewhat important

Not very important

Not important at all

23. What type of educational background do you prefer interpreters to have in your specific discipline?

No educational background

Some educational background

At least a two year degree

At least a four year degree

At least graduate level education

24. How important is it to you that interpreters have training (e.g., workshops, classes, seminars) for interpreting in your specific discipline?

Very important

Somewhat important

Not very important

Not important at all

25. How important is it to you that interpreters understand the specific vocabulary and jargon unique to your discipline?

Very important

Somewhat important

Not very important

Not important at all

26. How important is it to you that interpreters in your discipline are able to decipher foreign language accents?

Very important

Somewhat important

Not very important

Not important at all

n/a

27. When your colleagues present a paper or research or lead a meeting at your place of employment or a conference, how important is it to you that interpreters do preparation work beforehand?

Very important

Somewhat important

Not very important

Not important at all

n/a

28. When you present a paper or research or lead a meeting at your place of employment or a conference, how important is it to you that interpreters do preparation work beforehand?

Very important

Somewhat important

Not very important

Not important at all

n/a

29. If applicable, how do you expect interpreters to prepare for your presentations?

30. When interpreters in your discipline encounter concepts they do not understand while interpreting, how do you expect them to address the issue?

31. Do you feel interpreters in your discipline should advocate for their own needs (e.g., ample breaks, appropriate seating) or do you prefer to advocate for the interpreters' needs?

I prefer to advocate for interpreters' needs

I prefer interpreters advocate for their own needs

Other (please specify)

32. How important is it to you that interpreters in your discipline be flexible with differing work environments (e.g., field work, lab meetings, research cruises)?

Very important

Somewhat important

Not very important

Not important at all

n/a

Other (please specify)

33. What are other competencies or skills that you feel interpreters in your discipline must possess that have not been mentioned in this survey?