Access to Knowledge
The Issue of Deaf Students and More

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Abstract   Language and communication barriers undermine everyday life for deaf people. In particular in higher education settings, these students often receive limited information and thus struggle to gain full access to knowledge. Considering these linguistic issues from several perspectives, this paper highlights some of the problems that arise in the everyday life of deaf students. Possible short- and long-term solutions to these barriers are presented and discussed. For example, simplified written texts ensure clarity and immediate access to complex and technical texts, but only provide one step toward linguistic autonomy. Linguistic mediation through sign language guarantees both direct access to content and personal involvement in interactive settings.

Summary   1 Introduction. – 2 Communication and Linguistic Issues. – 3 The Need for Simplified Written Texts. – 4 Sign Language as a Medium. – 5 Conclusion.

Keywords   Special education. Access to knowledge. Linguistic barriers. Deaf students.

1   Introduction

Access to scientific content throughout a deaf person's lifetime of learning is key to making higher education accessible to deaf people in the long term. Throughout the world, deaf people experience limited access to higher levels of education, with the situation being especially worse in some European countries compared to others. Unfortunately, systematic information about the number of deaf people enrolled in higher education programs, the dropout rate, and the percentage of those who complete their academic career is hard to find.

For instance, according to an Italian National Institute of Statistics (ISTAT) 2009 report (Solipaca 2009), the number of deaf students enrolled at Italian universities has gradually increased over recent years, as shown in Table 1.[1]

[1]   Data come from the MIUR-CINECA (Ministero dell'Università e della Ricerca – Consorzio Interuniversitario) database. The enrolment statistics for undergraduate and graduate students with disabilities in Italian universities from 2000/2001 to 2004/2005 can be ac-

Table 1: Deaf students enrolled in Italian Universities from 2000 to 2007

Academic year	Enrolled students (deaf)
2000/01	314
2001/02	368
2002/03	449
2003/04	470
2004/05	542
2005/06	567
2006/07	630

However, these data need to be considered carefully since they do not provide much information about the typology of the deaf population. For instance, there is no indication as to whether these numbers refer to prelingually deaf people or extend to late deafened people, nor whether the numbers include hard of hearing people or only profoundly deaf people, nor do the numbers make a distinction between signers and oralists. Furthermore, these data only indicate the numbers of enrolled students, thus failing to provide more critical data such as the number of students who complete the program versus dropout rates. Nonetheless, the Italian data are relevant because they reveal a consistent increase in the seven-year period under consideration in which the number of deaf students at the university level doubled from 2000 to 2007. Such results may be due to a better understanding of the specific needs of deaf students and to the gradual improvement of lecture accessibility (e.g., several universities started offering Italian/Italian Sign Language (LIS) interpretation for class lectures as part of the services offered to deaf students during this time[2]).

However, we must also consider that university reforms in Italy caused a substantial increase in the overall number of students enrolled over the same period,[3] as shown in the third column of Table 2. The increment of the deaf population and that of the hearing one are not correlated (Pearson's correlation index = -.075, p = .887). This fact indicates that the trend of enrolment of deaf students does not depend on the university reforms.

cessed in Solipaca 2009 (ISTAT report), and from 2001/2002 to 2006/2007 can be accessed here in Greco 2016, 71.

2   Some universities also provide tutors that take notes for deaf students, including Ca' Foscari University of Venice.

3   The enrolment statistics for the overall undergraduate and graduate students in Italian universities come from the CNSV (Comitato nazionale per la valutazione del sistema universitario) 2011 report. URL `http://www.cnvsu.it/_library/downloadfile.asp?id=11778` (2016-07-23).

Table 2. Deaf students enrolled in Italian Universities in comparison to the overall population of enrolled students (from 2000 to 2007)

Academic year	Enrolled students (deaf)	Enrolled students (total)	Percentages of deaf students over the total number of students
2000/01	314	1,688,804	0.0186%
2001/02	368	1,722,457	0.0214%
2002/03	449	1,768,295	0.0254%
2003/04	470	1,814,048	0.0259%
2004/05	542	1,820,221	0.0298%
2005/06	567	1,823,886	0.0311%
2006/07	630	1,810,101	0.0348%

Just the same, the last column of Table 2 indicates the percentages of deaf students over the total number of students per year, showing that there is an increase of the deaf population which is independent of the increase of the general population of students. The incremental curves in figure 1 show the growing trend of the deaf students when compared with hearing students.
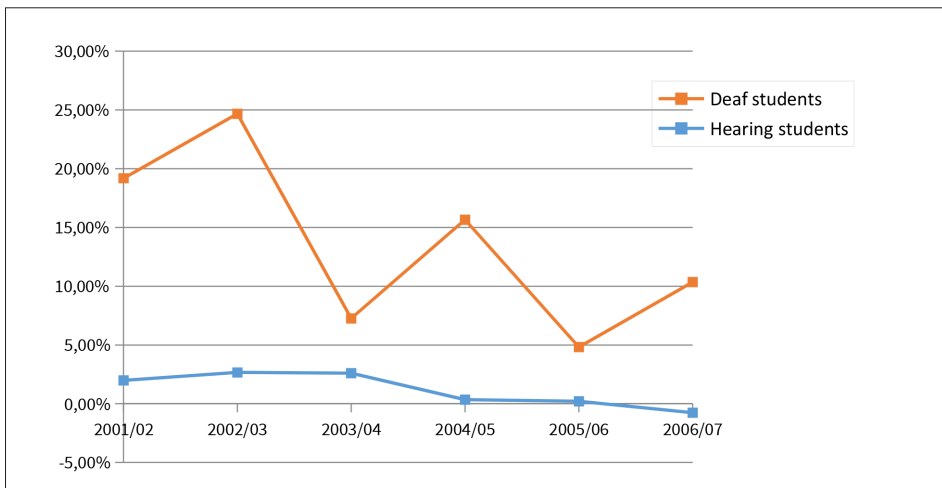

Figure 1. Percent change in enrollment from year to year in Italian universities (deaf vs hearing population of students)

Given the higher quality of services offered to deaf students, we would predict a further increase in the number of enrolled deaf students.

Despite growing numbers, the situation for deaf people in higher levels of education is, we believe, unsatisfactory not only in Italy but through-

out the European Union. There are several reasons why this is so. The most important one, we believe, is connected with the issue of language and how information is transmitted to deaf students. It should go without saying that deaf people access information mainly visually rather than auditorily, imposing several restrictions on how content is best transmitted to a mixed audience of hearing and deaf students. But even before this can be considered, there are even more basic issues concerning language skills that must be addressed. For example, while it is true that deaf people are multilingual in the sense that they must navigate at least one signed and one spoken language on a daily basis, it is also true that their competence in that spoken language rarely reaches levels which are adequate for the needs of higher education. Add to this the additional requirement of understanding the dominant language used in scientific contexts, namely English, which imposes further burden on deaf people living in non-Anglophone countries.

Language and communication issues cannot, however, simply be addressed in the context of higher education – they have to be considered within a broader perspective of lifelong learning. Certainly, planning ad hoc solutions during higher levels of education would make life easier for those few students who already meet the requirements for accessing these levels, but such solutions would not help to solve the access problem for the large majority of deaf students who do not meet these requirements. It is naïve to believe that the language gap can be bridged at the end of (or even after) the high school years.

An additional, non-trivial aspect of deaf students' achievement is connected to the motivations for deaf people to continue their academic carriers. While it is true that higher levels of education generally correspond to better job positions and to overall better social conditions in hearing communities, this is not necessarily true for deaf people, especially in Europe. In many European countries, people with disabilities (including deaf people) have privileged access to middle-class jobs both in public and in private institutions, irrespectively of the quality of their training. This has the implicit side-effect of making college degrees less useful for these people.[4] However, the overall situation of the job market has become more fluid in the past twenty years (Castells 1996, 1997, 1998) and continues to undergo a dramatic but silent change. Today's network society is imposing new organization on work, requiring increasingly sophisticated skills for the same types of jobs (e.g., the introduction of software applications in public administration). While many of these skills may be gained though implicit learning (Cleeremans 1997) among hearing people, they rarely

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4   Indeed, many deaf people start their university career once they already have a permanent position. This notably increases the probability of dropout.

reach deaf people given linguistic barriers.[5] It is likely that in the coming years, protected middle-class jobs will be out of the range of deaf people, with negative consequences for their social condition.

Linguistic and communication barriers undermine everyday life for deaf people, prompting them to enter higher levels of education where effective knowledge can be mastered. However, a person's motivation to pursue higher levels of education should not depend solely on social needs, but should rather emerge out of the natural individual inclination toward some scientific aspect of human life. Still, this can only be realized if scientific knowledge is sufficiently prevalent within the community. Indeed, deaf adults, parents of deaf children, or even leading personalities in the community become potential educators. If these people find interest in the sciences in the broad sense of the term, it is likely that this interest will be transmitted to the younger generations. However, given that access to scientific knowledge among the general deaf population is extremely reduced and fragmented, these types of role models largely cannot be found. The issue then becomes: how can deaf people let their natural inclinations toward science emerge if access to scientific knowledge within the broader community is basically nonexistent? Taking this broad perspective, it is important to keep in mind that access to higher levels of education is only the final step of a long journey that starts from childhood and has to be encouraged by the student's surrounding environment.

In this paper, we will highlight some linguistic and communication barriers that may prevent deaf people from accessing higher levels of education, we will present some of the communication and linguistic difficulties that deaf people experience in higher levels of education, and we will highlight the relevance of a broader perspective if real accessibility is to be provided. A potential short-term solution for the question of spoken language competence is subsequently offered, followed by some justification for using sign languages (SL) for optimally transmitting information to deaf people.

2 Communication and Linguistic Issues

Several types of linguistic mediation are available to deaf students in higher education who would like to access scientific content, including tools and techniques that can help deaf students understand the hidden meanings in complex texts. However, any of these techniques requires for students to be fluent in the language of the dominant community before they can access

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5 Note that in old economy professional jobs (e.g., tailor, carpenter), implicit knowledge mainly passed via the visual channel, therefore language was never a barrier. This situation is simply not replicable in the Information Society – visual learning for these type of procedures is simply too difficult.

higher levels of education since most of a student's or researcher's activities involve the written form of a spoken language. How does a deaf person gain such a base in the dominant language? Sign language interpreters are rarely provided in situations where general knowledge can be acquired. On the contrary, standard television broadcasting companies often provide subtitles during their programming, with some variation based on national laws (e.g., in France only highly-watched TV shows are required to be subtitled). Additionally, differing theories on what information should be included in subtitles have emerged, and some subtitles may include only a simplified version of the broadcast language[6] (see § 3). For the transmission of scientific content, simplified subtitles are not an optimal or perhaps even viable solution (see § 4). For instance, text simplification can allow students to acquire new information quickly, but it is probably not sufficient to facilitate that student's linguistic autonomy.

So how then can deaf students master the language used in their books and manuals?

While acquiring a spoken language is not impossible for deaf people, as confirmed by those few cases of deaf people who have full linguistic competence in a spoken language even though they are profoundly deaf since birth, having reduced auditory access to a spoken language changes the language learning experience. It is most often the case that deaf people display difficulties in understanding and producing written texts. Though there is some heterogeneity in the attested language errors, it is possible to point out the most frequent ones for deaf students (Caselli et al. 2006, 234-242; Radelli 1998; Fabbretti, Volterra & Pontecorvo 1998; Fabbretti 2000; Tuller 2000; Volterra, Capirci & Caselli 2001; Chesi 2006; Volpato 2008, 2010a, 2010b; Bertone & Volpato 2009; Bertone et al. 2011; Franchi & Musola 2010, 2011; Trovato 2014). Generally deaf people have trouble with the reference of clitic pronouns; the function of determiners and prepositions; the role of copular, auxiliary, and modal verbs; the use of verbal and nominal morphology; complex sentences such as passive and relative clauses; and both lexical and syntactic ambiguity. As stressed before, such difficulties do not arise from a specific language disorder. Effortless acquisition of a sign language under appropriate exposure demonstrates that the language faculty is not defective in the deaf population. Just the same, while deaf people may reach a level of competence in the dominant language which allows them to live productive everyday lives, the issue of language becomes an obstacle when they have to deal with complex texts. Part of the difficulties may lie in lexical aspects as discussed below, but there are also linguistic issues concerning the syntax of the dominant language.

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6   Note that the Italian Deaf community via the National Deaf Association is not entirely in favor of using simplified texts on broadcast shows because of the risk of losing relevant information at the semantic and pragmatic levels.

What is missing in the linguistic competence of many deaf students is not so evident, at least at first sight. They may initially seem to succeed at deciphering many sentences, but in many cases comprehension is only partially obtained and heavily depends on non-syntactic strategies such as linear word order, lexical information, semantic plausibility, context, inferences, and world knowledge (Radelli 1998). Furthermore, while there are aspects of syntactic competence that are shared universally, it is at the level of crosslinguistic variation that the most relevant issues arise. For example, let us consider the use of sequence of tenses (*consecutio temporum*) in the verbal domain, or the use of clitic pronouns in the Romance domain. The examples below are taken from Chesi, who conducted a systematic investigation of the production errors made by deaf kids between 6 and 17 years old. In particular, (1) shows an incorrect sequence of tenses (2006, 96) and (2) shows a case of clitic omission (65).

(1)   Error: Il gatto segue il topo e poi il gatto faceva finta di essere una lampada.
        [The cat chases the mouse and then the cat pretended to be a lamp.]
        Target: Il gatto segue il topo e poi fa finta di essere una lampada.
        [The cat chases the mouse and then the cat pretends to be a lamp.]
(2)   Error: Il gatto prende la roba$_i$ e ø$_i$ mette sopra il topo.
        [The cat take the stuff$_i$ and put ø$_i$ over the mouse.]
        Target: Il gatto prende la roba$_i$ e la$_i$ mette sopra il topo.
        [The cat take the stuff$_i$ and put it$_i$ over the mouse.]

A similar concern should be raised for fine grained semantic aspects such as the behaviour of quantified expressions, exemplified by the ambiguous case in (3), and pronominal reference, as exemplified by the ambiguous case in (4) (Benincà & Tortora 2009, 20).

(3)   Tutti gli studenti hanno letto un libro.
        [Every student read one book.]
        Possible interpretations: Every student read a different book / There is a unique book such that every student read it.
(4)   Gli individui che si$_{imp/refl}$ erano presentati al direttore furono poi assunti.
        [the individuals that SI were presented to the director were then hired.]
        Possible interpretations: The individuals that one had introduced to the director were then hired (impersonal 'si') / The individuals that had introduced themselves to the director were then hired (reflexive 'si').

The generations of implicatures and the projections of presuppositions at the semantic/pragmatic interface are expected to be particularly problematic, too.

Effective communication in academic contexts also requires a stable technical vocabulary, which must be learned in the written language and

may pose additional problems for deaf students compared to their written language-fluent hearing counterparts. Technical vocabulary also poses a problem for sign language interpretation given the low equivalence between spoken/written words and signs in the technical domain. At the moment, various scientific disciplines have a restricted number of technical signs due to the fact that not many native signers have achieved a degree in those particular fields. The lack of stable lexical jargon could be overcome through several strategies such as creating neologisms, standardizing existing jargon, and developing and promoting scientific multimedia glossaries (see for instance the Spread the Sign lexicon, `http://www.spreadthesign.com`). From the perspective of the deaf community, recording new signs for previously undiscussed concepts provides a platform upon which students can learn about these new ideas. This may also provide a stronger sense of pride in signed languages by showing their versatility in describing complex concepts, perhaps ever more succinctly than spoken languages especially for highly visual concepts. For interpreters, having a lexicon of such signs that can be studied before entering the interpreted interaction gives them confidence in the interpretation and promotes clarity for the deaf consumer. This eliminates the interpreter having to overtly describe the concept being discussed or to fingerspell[7] the word.

As signed languages use three-dimensional space as well as time for grammatical purposes, whereas spoken languages are completely linear (temporal) in their organization, some grammatical incompatibilities arise during the interpretation or translation from spoken/written languages to signed languages. For example, the English sentence 'Johnny went home after it was dark', would likely be interpreted or translated into a signed language with the concepts 'getting dark' and 'Johnny going home' arranged in temporal order to reflect the reality of the situation being discussed. Signed languages can also place these concepts along a grammatical spatial timeline that extends from the signer's body forward (now to future) or from the signer's left to right (now to future, for a right-handed signer). These issues need to be considered both for the interpretation and translation of academic materials for deaf students.

3   The Need for Simplified Written Texts

A potential short-term solution for linguistic issues is found in simplified texts which can replace more typical texts for the sake of improved readability. A simplified text is essentially a text adaptation for didactic

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7 Fingerspelling is the use of a series of letter signs, often collectively called a 'manual alphabet', which represent the written version of a word from a spoken language.

purposes. By simplifying, the author modifies some lexical, syntactic and discourse features through either human or machine intervention (e.g., artificial intelligence software, Carroll et al. 1999). It is imperative however that during this process meaning and content should be neither altered nor reduced, rather that it should tailor the presentation to the linguistic skills of the student in order to facilitate access to new information. Common modifications include splitting long sentences, increasing the prevalence of unmarked word order, simplifying complex syntactic structures such as passive and relative clauses, removing clitic pronouns, substituting infrequent words with common ones, and increasing redundancy.

An illustrative example of text simplification is reported in (adapted from Brunato et al. 2015, 36), in which the following simplification strategies have been adopted: word reordering, explication, lexical substitution, and anaphoric replacement.

(5)   a.   Original text:
           Il passante gli spiegò che, per arrivare al bidone, doveva contare ben 5 bidoni a partire dal semaforo.
           'The passer-by explained him that, to get to the dustbin, he had to count exactly 5 dustbins starting from the traffic light.'
      b.   Simplified text:
           Il signore spiegò a Ugolino che doveva contare 5 bidoni a partire dal semaforo, per arrivare al bidone della carta.
           'The man explained to Little Hug that he had to count 5 dustbins starting from the traffic light, to get to the wastepaper dustbin.'

Generally, a simplified text is not meant to be static. In order to support the learning process, it can also include some visual cues such as boxes with vocabulary support, margin notes, keywords, pictures, and symbols (but see below for potential shortcomings of these strategies when used among deaf people).

Still, there is ongoing debate between those who believe that the text should fit the reader (i.e., advocates for simplification) and those who believe that the reader should fit the text (i.e., advocates for increased language learning among readers). Advocates of simplified texts emphasize the need for comprehensible input to support the learning process. Those on the other side of the debate claim that authentic texts should be preferred because they expose learners to natural language and allow them to improve their reading skills. To date, the literature is divided between the two camps (a.o. Power & Leigh 2000, Crossley et al. 2007).

Despite some criticism, text simplification is rather widespread in different educational settings and targets a number of populations. For instance, it can be useful with adults learning a foreign language for their continuing education, or helpful to second language learners of school age. Another possible application for simplified texts is in bilingual education where the

acquisition process of one of the two languages is delayed for some reason. Moreover, in both the educational and clinical environments, special adaptation may be necessary with cases of various language disorders, such as specific language impairment, dyslexia, and aphasia.

Returning, though, to our study of deaf learners, it would be interesting to assess how useful this technique can be for deaf people. In higher education programs most scientific content is transmitted in the written form using lexical jargon and complex sentence constructions. If these texts are not aligned with the linguistic competence of deaf students, the reading process inevitably slows down, causing reduced motivation and a potential lack of interest in the discipline.

These facts bring up some questions to consider regarding the applicability and benefits of text simplification. For instance, should scientific terminology be constantly replaced by commonly used words? Does adaptation allow deaf students to familiarize themselves with academic discourse? Finally, will these students be linguistically competent enough to produce their own scientific work in the upper levels of education?

Simplified texts are functional for the purpose of providing immediate access to content, but they should only be considered in terms of their long-term implications. If deaf students are methodically exposed to new linguistic features they could potentially improve their competence while learning and at the same time increase their self-confidence. That is precisely the reason why simplification should be gradually waned according to a single student's dynamic language skills, being as temporary as possible in order to enable the student to gain linguistic autonomy.

In addition to application in educational contexts, text simplification may also be useful in everyday life since we know that the Information Society relies heavily on written texts given that the Internet is accessible mostly in textual form. Again, the process of adapting texts should not reduce them to summaries or abridged versions of themselves, given that transmitting a restricted amount of information to the student would be an unwanted outcome.

A recently developed spin-off within the Ca' Foscari University of Venice, VEASYT (`http://www.veasyt.com`), is witness to new understandings toward special needs. This project aims to offer multimedia guides about local tourist sites in an inclusive and accessible way. The informative materials contain simplified text, sign language, audio, and images, and manage to target a large number of people including those with hearing, visual, and language impairments. In some instances, specialized terms from the fields of architecture and art (e.g. loggia, Corinthian column, keystone) can be preserved in the simplified version because comprehension is supported by visual aids. The main aim of this particular approach is to make common knowledge available among the entire population, including those with special needs.

4   Sign Language as a Medium

The traditional model for lectures within higher education is not ideal for deaf students. Standard visual aids normally used during lectures like slides or handouts can even worsen the situation if they overload the visual channel. Obviously for hearing students these tools complement what the instructor says, and it often happens that speech overlaps with the requirement to look at slides (e.g. because there is a picture to comment on, or an example to discuss). In this situation, the content is transmitted by two channels, the auditory one and the visual one, a combination not available to deaf students. The same situation occurs with the use of the blackboard. While it would be possible to adopt the best practice of avoiding information overlap via a careful timing of the presentation, this would only be a short-term solution. If used systematically, this approach would stretch the length of the lesson, forcing the whole program to be reduced. This approach would be further complicated by the fact that what a teacher says in class does not directly reach the deaf student, as there must be an intermediate step in which the spoken message is transformed into a signed message. This can be done in some more or less efficient ways, though we consider the best situation to be the use of a signed language interpreter.

A professional interpreter acts as a real-time link between two people who use different languages. In the case of deaf students in an otherwise hearing classroom, interpreters convey spoken messages through a signed language, i.e., through a natural language that is produced in the visual channel. The main advantages of using a sign language are direct access to content and personal involvement in interactive settings.

The process of interpreting requires three main steps: first, the interpreter must receive and understand the input; second, (s)he must construct meaning from this input; and third, (s)he must deliver equivalent meaning in the target language. In sequential interpreting, the interpreter receives an entire phrase before the speaker pauses to allow the interpreter to provide the interpretation. This setting is considered ideal for the highest quality of interpretation. In this specific case, the three steps of the interpreting process happen independently and in order. This is because the pause allows the interpreter to construct meaning without further input and to provide an equivalent interpretation before the speaker continues with more input. However, signed language interpreters most commonly work in simultaneous interpreting situations (especially in higher education) wherein the speaker provides input at a natural pace and does not provide pauses for the interpreter to go through the steps of interpretation. Instead, the interpreter is expected to do all three tasks at the same time, receiving input all while constructing meaning and providing output.

It is important to keep in mind that the hearing students in the classroom are only required to do some of the cognitive tasks that the inter-

preter does, that is, the hearing students are only required to receive the input and make sense of it in their first language before moving on to other input. Even for hearing students, this task is not easy and can prove overwhelming when new content is introduced or high-level topics are discussed. For the interpreter, this simultaneous mode of interpreting negatively affects the quality of the interpretation for all involved parties – by degrading certain parts of the target message from cognitive overload, or by requiring interruptions of the speaker by the interpreter for the purposes of requesting clarification. Some ways that this can be resolved are detailed below.

First, it is a common practice among signed language interpreters to work in teams of two or more during long or challenging interpreting situations. A team interpreter can provide immediate feedback on any of the three steps listed above: (s)he can provide a word that was not heard; (s)he can help clarify meaning of new, foreign, or semantically heavy words; and (s)he can correct the output should an error arise. In these situations, the 'active' interpreter can focus more on constructing meaning in a general sense and the 'passive' interpreter can focus more on provide clarifications or specifications when necessary.

Second, using a long interpretation processing time (also called a décalage, or delay) gives the interpreter more time to construct true meaning in step two. Because of the challenging cognitive task interpreting represents, interpreters already introduce a delay into the interpreted interaction that has consequences on the interaction. Participants who use the target language, for example, often miss out on being able to ask questions because they are receiving a delayed input where the appropriate turn taking pauses are no longer aligned with those in the source language. Shortening the processing time would help mitigate the effect of the interpretation on turn taking, but would jeopardize the interpretation fidelity.

Third, having a knowledge of the material at hand allows the interpreter to call upon previously-constructed meaning in step two, arguably the most difficult of the steps. The interpreter community quite stringently requests preparatory materials to be provided well in advance of the interpreted interaction to ensure that interpreter provides the truest interpretation possible. In the context of the university, this often requires that interpreters be trained at the university level in a field *other than* interpreting. Unfortunately, in many interpreting programs, students take only language, culture, and interpreting practice courses and rarely are exposed to the likes of a university chemistry laboratory or textbook. It could be argued that it is impossible to interpret something that one knows nothing about. It is for this reason that university-level interpreters must be especially careful to have the right prior knowledge before accepting work assignments.

Attempting to take notes in class also presents itself as a difficult task for a deaf person when in a hearing class. This is because similarly to the above

observations on the ability of the deaf student to watch an interpreter and a slide presentation at the same time, it is impossible for a deaf person to watch a lecture in a signed language and look at his/her notepad to take notes simultaneously – the scientific nature of vision does not allow for this to occur. Some might suggest, then, that hiring a note taker for the deaf student or providing the deaf student with a video recording of the class could help with this important part of the learning process. Unfortunately, these suggestions rarely become solutions, as every person takes notes in a unique manner and university students do not generally have the time to re-watch a professor's lecture (hence the existence of notes at all). Deaf students generally must have a strong command of working memory in order to find appropriate breaks in the discourse to write dense notes on the lecture material.

One solution that is sometimes raised is the use of CART (Communication Access Real-Time Translation), which is a speech-to-text technology not unlike court reporting. This requires a specially-trained stenographer to listen to a spoken presentation and transcribe it into a written language. The benefits of such a system are that no interpretation happens during this process and thus the discourse remains within a single language, and that the resulting text file can be saved and distributed to the audience for them to have a record of the lecture. On the other hand, the stenography process requires that language only flow from the spoken medium to the text medium, thus prohibiting deaf students from responding to questions or otherwise interacting in the classroom. Also, prosodic markers are generally lost in CART transcriptions, unlike in human interpretation. Finally, understanding a CART transcription requires that a deaf person have a strong command of a written language, the letters of which represent sounds to which the deaf person has limited or no sensorial access. This makes CART a solution generally only viable for specific deaf consumers or when used in tandem with signed language interpreters. For most deaf students, accessing material in a signed language is preferable to accessing it in a written language.

All these facts raise non-trivial questions: is the timing of a lecture designed for hearing people compatible with the timing of a lecture for deaf student (e.g., is there sufficient time for the deaf student to take notes, are there sufficient visual rest periods in the lecture period)? Are classes designed for hearing people compatible with the needs of a deaf audience (e.g., are sight lines acceptable for deaf people, are deaf people able to participate in classroom conversations or debates without forcing pragmatically-awkward moments on the spoken language discourse)? What is the role of written language in the instruction of deaf students?

Despite the fact that these questions have existed for many years and that various proposals have been put forth to remedy them (Thumann 2007), it remains true that when a deaf student steps into a classroom academics do not generally know how to behave. This is likely due to the fact that there are so few deaf students that access high levels of education. Often

it becomes the role of the interpreter to educate the instructor on how best to direct the class for the deaf student and to ensure that the deaf student asks questions at the appropriate time in the discourse. This again supports the use of interpreters in higher level educational settings to provide solutions to problems that technology otherwise could not provide.

Of course, providing education directly in a signed language resolves the issues that are discussed here. This occurs at Gallaudet University and the National Technical Institute for the Deaf (NTID), both in the United States. Gallaudet is the only university in the world completely devoted to university-level education for deaf people. Classes at Gallaudet are taught in American Sign Language so that students have direct access to the content and do not require interpreter involvement. NTID is one college at the Rochester Institute of Technology and provides a similar approach to Gallaudet. Such academic models have not been copied in other countries in the world, potentially because of the financial cost involved with setting up such institutions, especially in light of the amount of people in a country that would attend this type of institution. Should deaf higher education become an issue of European concern, this model might be more efficiently adopted at the level of the European Union rather than within individual member states.

One issue that has not been addressed in any country is the accessibility of frozen learning materials for deaf students. Even at Gallaudet and NTID, deaf students are largely required to learn by reading texts in English or another written language, once again, languages that are based on sounds to which a deaf person has limited or no access. The development of educational materials in signed languages is an interesting research direction that should be explored for the entire academic life of the deaf student. For example, building a solid base in science from a young age will lead to success in scientific studies (and studies in other fields) throughout life. This also presents a strong opportunity for deaf professionals to be involved in creating texts that will directly benefit their own community and provide jobs to community members who may have trouble finding steady work.

5 Conclusion

Among the students enrolled in university programs, deaf people encounter communication and linguistic barriers in their everyday lives. In this paper we have highlighted some of these challenges and have given some possible short-term and long-term solutions. Access to the spoken language of the dominant community (and to the language of the scientific community) is a goal that would allow deaf students to be autonomous in their academic carriers. However, this result cannot be achieved without considering that the primary language of communication for deaf people is usually a signed language. Signed languages thus become the key to break the sound barrier.

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