Young children learning and understanding number and mathematical reasoning using BSL

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No part of this thesis has previously been submitted for a degree at Durham University or any other University.

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Acknowledgements

I would like to thank my supervisor, Dr SJ Hannahs for his support in encouraging me along the academic path of questions related to this research thesis.

I extend my gratitude to Anna Gehrke for her wonderful interpreting work as my first language is British Sign Language. Thanks also to Granville Tate who supported me and kept my morale high when I needed it. Without Anna and Granville this project would never have got off the ground.

Abstract

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Deaf children whose preferred language is BSL are being taught mathematics and assessed in English (a second language for them). If deaf children are underachieving in mathematics, it is likely related to the fact that they are (often) not taught mathematics in their native/preferred language, BSL, or assessed in their native/preferred language. These children are either taught through spoken English, 'signs supporting English' (spoken English with the use of gestures and sign vocabulary borrowed from BSL but impoverished grammatically), or impoverished BSL. Some of these children are fortunate to be taught by teachers fluent in BSL, by Deaf native users of the language or fluent 2L BSL users.

The majority of these children have parents who did not have knowledge of BSL when they were born and who often do not develop fluent BSL after their children are recognised as deaf. These children who are biologically suited to visual language development often acquire BSL through impoverished parental input, through contact with other children, from teachers (impoverished for some) BSL. Some of these children will be fortunate in having Deaf, native BSL user contact pre-school and through formal schooling.

40 years of research have shown sign languages of the world to be linguistically comparable to spoken languages: they are true languages. My hypothesis is that the children's knowledge of BSL does support the development of the kinds of abstract reasoning involved in learning mathematics but that this is often not recognised or valued.

This research focuses on children's use of BSL for counting and mathematical reasoning. I do this by looking at the literature and research on this area and use a recently developed BSL translation of a primary school assessment of mathematics. G.Tate, J.Collins and P.Tymms (2003). The approach of this study of learning mathematics by the use of BSL is from a linguistics perspective.

Using randomly selected examples from previously translated (written English to BSL) assessment questions, this research explores the issues involved in translating such questions, and takes a detailed look at the linguistic features of BSL in relation to mathematics concepts.

The dominant educational perspective for the education of deaf children is that success in the learning of mathematics (or other 'academic' subjects) is one which is valid only from its understanding through the use of English. Understanding achieved through the use of BSL is largely ignored or devalued. Children in the charge of these teachers and from research perspectives are often seen as having problems learning mathematics because of difficulties associated with using English. For example, Barham and Bishop (1991) list structures in English that have been found to create difficulties in learning mathematical ways of thinking. They list these as; conditionals, comparatives, negatives, inferentials, 'low information pronouns' and 'lengthy passages.' (Barham and Bishop p181). This exhibits an attitude of ignorance at the very least towards signed language.

The whole approach of these and other authors is to take a blinkered look at learning through English as having difficulties because of deafness. Rarely if ever is learning through using sign language considered as valuable (invaluable) in its own right.

'... the child is introduced to new and potentially confusing words, e.g. 'multiply' and rectangle.' Often there is confusion between words which might sound similar, especially to a child who is employing lip-reading, e.g. 'ten' and 'tenths,' 'sixty' and 'sixteen.' (ibid p 181)

More recent research by Nunes and Moreno (1998) shows some evidence of how young BSL users can develop ways of thinking mathematically through the use of BSL but still conclude that,

'...the nowadays common belief that the use of BSL in the home has compensatory effects on children's learning cannot be accepted without further investigation; (p253).

Nunes and Moreno do, however, show that children using BSL do develop mathematical ways of thinking at a similar rate to children whose first language is spoken English even though they may be well behind as a group. Their focus is on cognition rather than language.

The assessments they used were given in either English or translations into BSL or English with the use of gestures (which they term 'Sign Supported English'). But the actual use of BSL from a linguistic perspective is not questioned or a focus of the research. There is no record of what is signed to refer to, as there are records of English. BSL does not have a commonly used written form.

They do not look into the way BSL grammatical constructions are linked to mathematical reasoning. They do not look into the way gestures used with spoken English may only aid communication in English. They have no interest in developing an understanding of BSL:

the way numbers are signed, the way base ten counting can be achieved comprehensively, the way the spatial grammar of location and direction leads to the development of reasoning which includes addition, subtraction, multiplication and division.

I present a description of assessment questions in BSL in linguistic terms and discuss the grammatical structures in terms of their connections to mathematical ways of thinking (for example, as they relate to addition and multiplication and shapes) and therefore how fluency in and linguistic knowledge of BSL is desirable for teaching children whose preferred language is signed.

Introduction

The aim of this research is to look at the teaching of mathematics and the use of British Sign Language in Deaf Education and in the Deaf community, and to examine mathematical assessments for young deaf children, and relate these to wider and related developments in the nature of education for deaf children historically to the present.

BSL is the language of the Deaf community in Britain. The Deaf community consists of people who have a profound hearing loss, often from birth. They become members of the Deaf community either because they are born into a Deaf family or they identify strongly with the community through the use of its language and through its cultural life. Through the centuries there have been barriers to using sign language and conflicts between the medical model of deafness and the Deaf community. Deaf people define themselves as members of a sign linguistic and cultural minority group.

Traditionally deaf education has been beset by controversy regarding the best way to use sign language and even whether signing should be included or not. In the UK, there has been a general shift away from strict oral methods of educating deaf children towards an acceptance of sign language for use in the classroom. This shift is not complete, however, and there the influence of oralism is still felt in the use of teaching methods other than the bilingual method. Recent (March 2003) recognition of British Sign Language (BSL) by the UK Government as a full and proper language has had further implications for education.

Only ten percent of deaf children have Deaf parents and will acquire BSL naturally with their family using BSL in the home, in the same way as hearing children develop and maintain spoken language and hearing culture. Ninety percent of deaf children are born

into hearing families and will not usually acquire BSL until later in life when they attend either a deaf school or a mainstream school. However, BSL has been used for many generations in education and the Deaf community.

There has been a steady growth of research into education of deaf children the mathematics by hearing researchers. So far none of this research has been carried out by Deaf researchers who can use sign language. This research is just a beginning, and will look specifically at how mathematics assessments for school pupils are translated from English into BSL. A review of what relevant literature is available will bring into focus some glaring omissions and lead to many suggestions for future research.

One of the problems with research into how well deaf children are performing in mathematics is that hearing researchers have often neglected to look at the use of British Sign Language in the learning of mathematics and thus their findings can become skewed. Many deaf children have sign language as their first language, and thus any research carried out with them needs to have native signers, who can also provide a Deaf perspective, involved.

Baker-Shenk, C. & Kyle, J. (1990) state that it has always been the case that deafness has been treated as a handicap – a deviation from the normal. Medical developments have allowed society to more easily detect, classify and attempt to remedy lack of hearing.

This paper will address the issue often raised by Deaf professionals working in education: that the definition of terms hearing professionals are using, such as 'hearing impaired', must be examined closely. What does it mean for the Deaf community to be thus labelled by hearing professionals and hearing society in general? Mathematics is a skill acquired both at home and at school, and the research tries to look at how this happens for deaf

children. But, the research is always based on a medical model of deafness that portrays deaf children as 'impaired'.

Most studies of the attainments of deaf children have focused on language. However, in deaf education there is a situation where British Sign Language (BSL) is used in classrooms, and teachers and researchers in those classrooms often do not have a native command of that language. Deaf children in those classrooms often quickly develop a native command of BSL even if they arrived at school without having been exposed to sign language, because they are influenced by the fluent signing of deaf children who have Deaf parents. Therefore teachers and researchers may misunderstand the natural signs produced by deaf children.

This paper will raise the issue that sign language is a true human language, which cannot be ignored. The medical profession must be challenged as to why they are ignoring a human language which has its own linguistics and is used every day by Deaf people in the Deaf community.

> Research work has come mainly from psychologists, educators, medical practitioners, and scientists attempting to highlight the extent of the perceived retardation caused by deafness or else attempting to bypass deafness altogether. For only 20 years has there been any hint that deaf people's 'gesturing' might have the characteristics of a language and that this language could be studied. This realisation has changed some researchers views of deafness but has also led to new problems because of the history of the treatment of deaf people. While it offers the researcher a new avenue into the community, it has also led to mutually frustrating attempts at cross-cultural collaboration. Baker-Shenk, C. & Kyle, J. (1990).

This introduction starts by analysing whether there is a specific problem for deaf children in mathematics. The available research that attempts to answer this question is all published by hearing professionals, except for one piece by myself, (2003) published in the journal 'Deaf Worlds' in which I work with hearing professionals who possess skills in sign language to look at the use of sign language in mathematics education. In chapter 3 examples of how BSL can be used in the classroom will be discussed, and in Chapter 6 different ways of signing numbers will be described.

Each chapter will look at a different aspect of the use of sign language in mathematics. The first six chapters focus on different aspects of developments in deaf education and whether sign language has been included or excluded. I will also consider whether the sign language used by deaf children talking about mathematics has been fully understood by the teachers working with them and the researchers who have attempted to study their levels of achievement. Chapters 7.1 and 7.2 will look at translations of mathematics assessments for deaf pupils and examine whether there are any implications for the assessments when they are translated.

It is important to mention that studies of British Sign Language and how it relates to mathematics and numbers are rare. Part of the aim of this dissertation is to address this gap, and to gain a better understanding of how numbers are signed so that hearing people working in this field can benefit. This is the reason it is important to have a Deaf researcher carrying out this work. Issues will be identified throughout each chapter with the aim of putting a complete picture of the problems involved together. Research like this will, I hope, change the situation for the better for deaf children using sign language to learn about mathematics and numbers.

Chapter 1

Sign Language: a language that cannot be ignored:

What do Deaf people mean when we say, "sign language has been ignored"? Particularly since 1880, as a result of a large congress on deaf education held in Milan, sign language has been largely ignored by hearing professionals. Hearing people who have been involved with Deaf people throughout most of their history have controlled the use of sign language. Hearing Teachers of the Deaf have believed in and taught via the oral method, and this worldwide phenomenon has meant that Deaf people themselves were seen as inappropriate language models for deaf children because they could not model spoken language, and thus sidelined in deaf education.

Deaf people to this day hold on to bitterness about the name 'Milan', and the sign MILAN has a double meaning – it can be used for the city in Italy, but more commonly is used to mean the beginning of the oppression of sign language, and the spread of the oral education system all over the world (so we find sentences, for example, that begin SINCE MILAN...). There is much emotion tied up with this sign, since the congress effectively destroyed the language of Deaf people, and pushed it underground.

> The second "International Congress on the Deaf" was in fact very unrepresentative. Out of 164 delegates there were 93 Italians, 56 French, 8 British, and 5 from the USA. Only one (American) delegate was deaf. Yet at the time nearly half the teachers of the deaf in the USA and two thirds of the teachers at the famous Paris Institution for Deaf were themselves deaf. (Collins and Baker (1989), p. 44)

This was the second "International Congress on the Deaf", and resulted in so-called "pure oralism" sweeping through Europe and North America, and subsequently throughout most of the world. Oralism has a long-established role within the education of deaf children and continues to influence the development of develop teaching strategies and methodologies, particularly in response to current considerations about the development of spoken language in hearing children and to rapid advances in technology. After 1880 speech assumed greater and greater importance in the curriculum at the expense of general education. In schools for the deaf, repressive measures were brought in against sign language. (Baker & Collins 1990).

Before 1880 there were some Deaf people working in deaf schools in roles such as teachers, maids, woodwork tutors, domestics, and so on. Following the Milan conference, it was agreed to put a stop to deaf staff working in schools all over the participating countries. Deaf people were dismissed from deaf education because they were not considered to be good role models for spoken language. "..at the time nearly half the teachers of the deaf in the USA and two thirds of the teachers at the famous Paris Institution for Deaf were themselves deaf. The Milan Congress resolved that the education of deaf children should henceforth take place through speech alone to the exclusion of sign language." Baker, R. & Collins, J. (p44: 1989). 'Pure oralism' means only spoken language is used, and deaf students were not allowed to sign. But, Deaf people cannot speak in the same way people do in hearing society.

I have Deaf parents and am Deaf myself. My parents experienced a worse oppression in school than I did – my mother's teacher used to say, "Stop moving your hands about!", and in my father's classroom, pupils' hands were hit with a stick if they were caught signing in class. In my own schooling, we were allowed to sign to each other in class, but the teachers did not sign to us. In my classes, Teachers of the Deaf (TODs) wore

headphones and we had to try and watch their lips. They did not sign and we had to try to follow the movements of their mouth, even when they turned to write on the blackboard. It was very difficult and pupils often did not understand. I can remember asking another deaf pupil who could hear quite well to interpret for me. 'Teacher of the deaf' is a term that will be used throughout this paper, which means a teacher who is trained and qualified to work with deaf children. They qualify as a regular teacher first, then go on to further training to work with children with hearing loss.

There were also Catholic deaf schools, run by Fathers and nuns. I visited one once and saw a silver board with the words "Please use your voice so God can hear you clearly." The focus of this type of education was decibels of hearing loss, hearing tests, phonics, and so on. Teacher of the deaf training in universities often neglected to even mention sign language. The primary focus of their training was hearing loss and audiologist training. Children had to wear hearing aids which were to be used in classrooms all the time. A large part of a teacher's job was constantly checking hearing aid batteries.

Aftermath of Milan

One of the most radical moves was the wholesale dismissal of deaf teaching staff from the schools on the grounds that they would not present adequate models for spoken language, and presumably also out of fear that they might subvert the new orthodoxy. Until recently deaf people in Britain have been expressly excluded from teacher training by means of a hearing test at a pre-entry medical examination. (Baker & Collins 1990).

The basis for this type of education of deaf children was a medical model of deafness. Deaf people have campaigned about education for many years, but there is still a barrier between the medical profession and the Deaf community. Research has since established that an oral education with a focus on speech has failed deaf children. Deaf

children have failed to achieve basic reading levels and have failed in using written English as a second language. Teachers of the deaf have used a method of teaching that pushes English as a first language, and this does not work. Conrad (1979) found that, in terms of speech, only 41% of deaf school leavers had speech rated as fully intelligible even by their own teachers. (Collins & Baker 1990).

Conrad's study focused on a group of pupils at the end of their formal school career aged between 15 and 16.5 years. He tested 464 children with an average hearing loss of 70dB or more who were deaf before the age of three years. The study included both users and non-users of British Sign Language. Conrad's study focused on hearing loss & dB levels.

For Deaf people themselves, levels of hearing loss are insignificant. Deaf people label themselves Deaf if they use BSL, and, even though there are differences within the Deaf community in that some Deaf people can use the telephone, hear music, and so on, and others cannot, these differences are seen as relatively unimportant. It is the use of BSL that is valued.

Yet still, there has been very little research into the abilities and knowledge of BSL users as it is known and expressed in BSL. Conrad's study found the school leavers reading ability was on average six years behind non-deaf pupils. However, even though all the pupils were educated in schools by a method called 'oral' education, it may be surmised that many of the pupils used BSL amongst themselves and for some it was their home language.

> Throughout the early part of the 20th century considerable effort was spent in developing speech training techniques and technology for use in the education of deaf children. Speech assumed greater and greater importance in the curriculum

> at the expense of general education. The results of concentrating on speech were evaluated by Conrad (1979) who found that only 41% of deaf school leavers had speech rated as fully intelligible even by their own teachers, Furthermore 50% of deaf children were leaving school with reading ages of less than 9 years and 28% with reading ages less than 7 years. (Baker & Collins 1990)

From the 20th Century and into the 21st Century there have existed barriers between the medical model and the Deaf community. Hearing professionals advocate technological 'solutions' to deafness, such as cochlear implants which are now widespread across the UK. Deaf people respond by arguing that receivers of such technological advances will still always be Deaf. Hearing professionals do not talk about sign language, and are naïve about sign language. They worry about how deaf children will learn speech and fit into the hearing world, and choose to ignore the Deaf community. This is similar throughout the world. If one or more of a baby's parent's is Deaf, it will be scanned while still in the womb to diagnose whether it is deaf. Then hearing professionals approach the parents to offer advice and give them leaflets about cochlear implants. Sign language, and that Deaf adults will be important role models for a deaf child, is not mentioned.

In Leeds, where the Local Education Authority has a Sign Bilingual Policy, Deaf adults are brought in to meet mothers/parents of a deaf baby. Recognition of the true linguistic status of British Sign Language is leading to some new directions in the educational field: that sign language is a language and can be used in the transmission of learning. There are still concerns in the Deaf community about the future of technology like cochlear implants. These are currently widespread in small children, and more and more deaf babies are due to be implanted. Deaf people have expressed their objections, but hearing professionals continue to believe that they know best. It is Deaf people who know what it

is like to be Deaf in this world, and what being Deaf means, and their voice should not be ignored.

In 1912 George Veditz, a Deaf man wrote of himself and his community as "first, last, and for all time, the people of eye." (Padden & Humphries, 2005) p2.

George Veditz worried about of the future of the sign language in 1913, and today there are still Deaf people who would prohibit the use of sign language and develop methods of education that would isolate deaf children from sign language. Today, the same concerns exist; there are doctors and teachers who say that they are ambivalent about the future of sign language while they are enthusiastic about the future of technology like cochlear implants. (Padden & Humphries 2005:16)

At one time there were 46 deaf schools in total in the UK. Deaf people are worried, but more predominantly angry, that deaf education is mainly in mainstream schools, and this policy has led to the closure of deaf schools. Today there are only 6 deaf schools left in England. Deaf children in some mainstream schools benefit from those schools having adopted a bilingual policy, but these are only a few.

> The inclusion of bilingual pilot projects in mainstream schools promotes access to the general curriculum and integration of the deaf child into the hearing community. In contrast, special schools defining themselves as clearly bilingual certainly have the advantage of bringing together deaf children of all ages, thus promoting their Deaf identity and their socialization in the Deaf community. Following the pressure of mainstream schooling, many special schools for deaf children face the general trend toward their closing. Where they remain, special schools have opted to vary their program, thus including bilingual teaching while

> focusing on the additional needs of deaf children with other difficulties. The Path toward Bilingualism (Plaza Pust 2004:148).

Deaf people continue to feel that there are barriers put in place between deaf children and the Deaf community, and that deaf children in mainstream schools are isolated. There may only be small numbers of deaf children in these schools, or a small deaf unit. Other deaf children are the only deaf person in their school, and are only visited intermittently by peripatetic a Teacher of the Deaf. Isolation from other deaf children also means that few children are able to benefit from mixing with those who have Deaf parents. However, sign bilingual policy has been adopted by some LEAs and has had some influence. It is now used in Leeds, at the Royal School for the Deaf in Derby, at Elmfield School, in Bristol and in Frank Barnes School for the Deaf. This means there are more Deaf instructors and Deaf assistants employed because they can use fluent BSL, which is vital for deaf children at preschool and nursery. The 90 percent of deaf children who have hearing parents, however, can get left behind in this signing environment.

"Hearing parents therefore struggle to make sense of their deaf child's identity" Ladd (2003 p175).

"Parents lack access to information about the relevance of sign language for the cognitive and social development of their deaf child". (Plaza Pust 2004:156).

I went to Deaf school at the age of 3. I can remember when I was in class; I put my hand up because I knew the answer to the teacher's questions. Her response was to put me in the corner to play with some toys. These 90% of deaf children with hearing parents were behind me because my family were Deaf and my first language was BSL. I had to wait for them to catch up to my level then teacher allowed me to join in again with them, which

showed me that it was a waste of my time and language. In effect, my educational progress was held back while the other pupils caught up to my level, because my language was more developed than theirs.

I'm one of the 10% of Deaf people born to Deaf parents. Deaf children of Deaf parents do not face the same challenges and problems as deaf children of hearing parents.

> Since more than 90 per cent of deaf children are born to hearing parents, the natural acquisition of sign language remains a privilege of deaf children born to deaf parents. (Plaza Pust 2004:154).

> What of the 90% of Deaf children who have hearing parents? Their world is often one of delayed and impoverished language input and limited interaction with nonsigning parents and peers. In these children, one can see clearly the symbiotic relation between language, social, and cognitive development disrupted. (U.Bellugi & E Klima 2000) The Signs of Language Revisited.

These 90% of deaf children are fortunate if their parents choose to go to sign language classes or to family support groups to learn to communicate with their deaf children. Not all parents do this. In 1994 a television programme (BBC – 'The Best of Both Worlds') filmed parents from Crook, Durham, with their deaf child. These parents refused to use sign language with their son, because they wanted him to use his hearing aid and to develop speech. He appeared very isolated and passive. In contrast, a family form Middlesbrough was filmed. These parents attended signing classes with their deaf boy. The father had achieved CACDP (Council of Advancement for Communication with Deaf People) BSL level 2 certificate, and the mother had a CACDP BSL level 1 certificate. They seemed a happy family all signing together, and visited Deaf clubs both here and in

other countries to meet Deaf friends. These parents had a good attitude and had fully accepted that their deaf child would have to acquire BSL as a language.

During 1984 I was involved in teaching a deaf boy named Ben at his nursery school (in the village of Denby Dale, Yorkshire), and also teaching a parent's group and the nursery staff sign language, so that they could all communicate with Ben. Ben's story is detailed in a book by his mother, Lorraine Fletcher, called 'A Language for Ben' A Child's Right to Sign (1987) and in a documentary by Tyne Tees TV (1985). I am sad that my mother never saw the programme as she died before the TV documentary was released. She was involved the documentary, because Ben was brought to my family home to see my home life with a Deaf family who use BSL, and also to see cultural artefacts such as flashing lights and flashing alarm clocks. Ben's parents wanted Ben to develop bilingually, using both BSL and English. The documentary won Recognition of Excellence in Television Movie Production for the year 1985 Tyne Tees Television in the category of Best Educational Production feature length. Ben's story was a landmark in the history of deaf education and is still much talked about in the Deaf community and in educational settings. Parents who are unsure of which approach to take with their deaf child are often referred to 'A Language for Ben' to help them consider using sign language.

> Sign Language is the only language Deaf people can learn in a natural way, without schooling, the same way as hearing children learn their surrounding language: in association with persons who use this language. Sign language should therefore be accepted as Deaf people's first language. The language is an important part of a person's identity. If the society accepts sign language, it also accepts the Deaf person as a human being. It gives children access to the Deaf community and the opportunity to, as adults, find a place in hearing and Deaf society. Deaf adults are the link between the children and the Deaf community.

Llewellyn-Jones, M. Bilingualism and the Education of Deaf children in LASER. (1987:23).

In 1987 I taught deaf primary aged children in a mainstream school in Leeds under the bilingual policy. I ran an Asian family support group for parents of deaf children, to teach them sign language. Some of the mothers spoke only Punjabi, but found sign language of great benefit to them in communicating with their deaf children at home. The main interactions between deaf children and their parents involve the exchange of information about school and about what they have learnt, about what to bring to school (such as gym clothes or swimming gear) and about school events like parties or trips. The family support group provided an environment where the parent or child could provide the teaching context. We found that there was a very early development in these children. They were highly visual and pointed to objects, described events visually, and dealt with nursery rhymes and even numbers in a visual manner. Their language progression, in fact, developed in much the same stages as it does with hearing children.

In the early 1970s, Ursula Bellugi and Ed Kilma were awarded a grant to study the acquisition of American Sign Language (ASL) by Deaf children. [....] their 30 years of sign language research and many implications for Deaf education. Bettger, G. B. (2000:324).

After the Milan Congress and the subsequent spread of oralism, sign language was effectively ignored by hearing professionals working with Deaf people. Researchers Bellugi and Kilma worked for many years to prove that sign language was still in existence within the Deaf community. Deaf people, while they have 'failed' in education under the oral method, have continued to a strong tradition of using sign language. Once it was established that the oral method of education was not working, every school changed their education policy to reflect either a Bilingual or 'Total Communication' philosophy. Total

Communication is explained in detail in Baker and Collins (1990). It is "a range of communication options from speech through written language and natural gesture to sign language, in which options were to be selected according to individual children's needs, the spoken language is supported by signs, with support spoken words. It was influential on the education of deaf children by 1960s from California but rapidly spreading worldwide. This method, currently known in the United States as Sim Com (Simultaneous Communication) means spoken message carries most of the information and the sign channel is not separate language. Experiments carried out in Denmark show that teachers couldn't even understand their Sim Com when replayed on video, without sound!" (Hansen, 1989). In what sense then is this communication either simultaneous or total? Sign language, like spoken languages, has a rich linguistics of its own.

Sim Com is an attempt to teach a spoken language by using signs as a support to that spoken language, and creates a kind of mixture of signing and speaking. Bilingual education is a different approach that accepts that sign language and spoken language are two separate entities. It encourages the attitude that sign language is a valid language in it's own right, in the same way that other spoken languages are valid.

> Attitudes to bilingualism have changed from negative to positive in recent years as the research evidence has demonstrated. No longer is bilingualism seen as being "a problem". Despite the claims being made for bilingualism, however, the impact on education is limited. As long ago as 1975 the Bullock report said, "no child should be expected to cast off the language and culture of home as he crosses the school threshold, to live and act as though school and home represented two totally separate and different cultures which have to be kept apart". The school should adopt a positive attitude to the pupil's bilingualism and whenever possible,

> help to maintain and deepen their knowledge of their mother tongue. Bullock, A. (1975) A Language for Life.

I will demonstrate in this paper that BSL is a language in its own right with own linguistic features. The following quote from Fromkin and Rodman explains some of the linguistic terms.

Like many spoken languages, sign languages have a rich morphology. They have root and affix morphemes, free and bound morphemes, lexical and grammatical morphemes, derivational and inflectional morphemes, and morphological rules for their combination to form signed words. Just as sign language have their own morphological, syntactic and semantic systems; they also have their equivalent of phonetics and phonology. The formal units corresponding to phonetic elements of spoken languages are referred to as primes. The signs of the language that correspond to morphemes or words can be specified by primes of three different classes: handshape configurations, the motion of the hand(s) toward or away from the body, and the place of the articulation, or locus, of the sign's movement (Fromkin and Rodman 1998:81).

"Sign languages are the languages used by Deaf people in which hand and body gestures form the morphemes and words". (Fromkin and Rodman 1998). This is an overall explanation for how meaning is constructed in sign language. In BSL, hand configurations are used with descriptive phrases. Borrowings from English occur in BSL in fingerspelled words and in English lip patterns that are used in conjunction with some signs such as number signs. Sutton-Spence and Woll explain fingerspelling:

> This represents the written form of English, not speech. It is possible to recreate any written English word by fingerspelling, with twenty-six hand–arrangements

> corresponding to the twenty-six letters of the English alphabet. By using these, fingerspellers can produce the spelling of an English word on their hands. Fingerspelling is not BSL though, because it does not use BSL vocabulary. However, BSL does use fingerspelling quite a lot, especially in some dialects. Sutton-Spence and Woll (1999:17).

Rowland, (1995:54) has said that forms used in teaching mathematics are usually written on paper. They are words, symbols and graphic materials and the interaction that happens during learning is between the pupil and a text. The learner is required to read a text. I agree with this statement, and I believe this leads us to one of the problem areas for teaching deaf children maths. If the learner is using texts on paper as their main source of learning about maths, they have few opportunities to use sign language to talk about maths. They are given handouts, and are required to read and write about maths everyday in schools, but do not have the chance to interact in BSL and develop understanding in signs related to maths. The reason is that most hearing Teachers of the Deaf are not qualified or fluent in BSL.

Keiran Fuson (in Durkin and Shire, 1991) states that children around the world learn number sequences in ways that are particular to their own cultures. Body parts (Sixe, 1982) or finger patterns (Zaslavsky, 1973) are firm number sequences and patterns that children learn by pointing at their fingers or body parts. Children use number words in sequences like counting. Numbers must match the objects in finger counting. This works in the same way as a spoken word would match the object, e.g. if a child saw one object, they would say the word "one". If they saw two objects, they would say the word "two". Sometimes children use their finger to point at the objects they are counting, and sometimes they use the words without pointing.

Teachers of the Deaf using the oral method do not allow children to move their fingers or use their hands to point at anything. The entire focus is on speech, and children were told to put their hands under their chairs, and 'say it using your voice'. But, it is natural for children to move their fingers along a row of objects, and I have seen this happen many times at primary schools in which I have worked.

Stories from many Deaf people reinforce the evidence that sign language was not allowed in classrooms and was only used outside in the playground, or was hidden from teachers' sight. Strategies such as forcing children to sit on their hands in class were employed to prevent signing. One example of this anecdotal evidence comes from a school in Ireland:

> In schools for the Deaf in Ireland the change from sign to oral methods took place during the 1950s. Oral schooling was introduced gradually and by 1960 pupils in oral programmes were segregated from pupils in programmes that used signs. The oralist approach dominated teacher training and audio equipment dominated the classroom. All forms of signing – whether sign language or signed English – were marginalised to non-mainstream classes. McDonnell, P. & Saunders, H. (1993) p256.

We cannot allow any children whether hearing or deaf to be stopped from using their fingers to point at or count objects. I believe that hearing children in every school are using their fingers to do this, but most people do not realise.

> Children sometimes move their finger along a row of objects saying words without really pointing at objects (a skim error) or produce a flurry of words and of points directed generally but not specifically at the objects (a flurry error). Both of these types of errors, as well as skipped objects errors, are particularly affected by the

effort with which children count: When children are asked 'to try really hard'. These errors decrease considerably. (K. Fuson's in Durkin 1991).

I recall doing observations in a primary school as part of my research. A child looking at two rows of objects had to decide which row had "more" or "less". The child had grown up using BSL. The child used pointing while counting the number of objects in each row. Then I asked him which row contained more (using the sign WHICH signed in the correct place to indicate a distinction between the two rows). The child looked but was unsure of the answer because there was only one object less in one of the rows.

However, he attempted to answer by using a 'B' (flat palm) handshape, curved so that the tips of his fingers were pointing at one row, and the base of his palm was pointing at the other row. He appeared to be hoping that I would think some part of his hand was pointing at the correct row and take that to mean he knew the answer. I asked him to point at one row only using only his forefinger, and he couldn't do it.

This was really interesting to me as a native BSL user. Teachers who are not fluent in BSL may accept an answer like this, believing that pointing with either part of the hand is acceptable in BSL, and he may have got away with his trick. To me, however, his clever use of his hand indicated very clearly that he did not know the answer to my question.

A test like this conducted in a spoken language would require a clear answer, or perhaps a hearing child would point at one of the rows of objects, but they would probably use their forefinger to point, and it would be clear. Deaf users of BSL can try to be clever in their use of different ways of pointing, and anyone conducting such a test in BSL must be careful of this.

The lexicons of spoken languages contain much variety, as do their grammatical rules, but historical relationships between languages mean that similarities can be found. There are also differences within 'one' language, for example, there is "American English" and "British English". Most sign languages, however, are distinct from each other, so there is American Sign Language, and British Sign Language, even though these two countries share the same spoken language. The sign languages are often named using the name of the country, so that in Sweden, for example, the sign language used is 'Swedish Sign Language', in Mexico, 'Mexican Sign Language' is used, in Kenya, it is 'Kenyan Sign Language'. Around Africa, we find the same phenomenon: Zambia has 'Zambian Sign Language'; Cameroon has 'Cameroon Sign Language'. Each country has it's own sign language, but the exact number of different sign languages in the world is unknown.

> American Sign Language" (ASL). The name placed it in the class of human languages, and commanded a different view of its history. The redefinition also made clear that there were many different signed languages around the world, each with a different structure and history, from Japanese Sign Language to Ugandan Sign Language to Brazilian Sign Language. American Sign Language is used in the United States and in English-speaking areas of Canada, and is distinct from other European signed languages including British Sign Language. Inside Deaf Culture (C.Padden & T. Humphries P2 2005).

"There already exist naturally evolved national sign languages such as British sign Language (BSL) and American Sign Language (ASL) each with their own strong cultural traditions, and each capable of encoding human experience as fully any other human language". (Baker, R. & Collins, J. 1989 p47).

Padden and Humphries (2005) have also said:

> British sign Language is not related to American Sign Language because of a fact about schools for deaf children: the first deaf school in the United States was founded in 1817 not by a Deaf British signer, but by a Deaf French signer, whose influence on ASL can still be seen today in some of the vocabulary ASL shares with the French sign language, LSF. Inside Deaf Culture (C.Padden & T. Humphries 2005 p2.)

Emmorey (Language, Cognition, and the Brain: 2001:2) says, the exact number of sign languages in the world is unknown". Hearing Australian Aboriginal people use a sign language when they are in mourning, when silence is required." (Kevov, 1984). "Their sign system is very different, however, to a primary sign language used by a Deaf community. The aboriginal signed language is linked to their spoken language and is used by hearing people for a specific purpose. It is not related to the signed languages of Deaf people. (Emmorey: 2001).

BSL has been used for many generations, but there is a paucity of written history of the language, and this also affects the history of how Deaf pupils have been taught mathematics. Oral methods have been used since the1880, and consequently research into maths education of Deaf pupils has focussed solely on this, and there is nothing written about the use of sign language for this purpose. Deaf children develop BSL as their first language, but hearing researchers and educators only think of English as a language to be considered. With English as their first language, they do research on Deaf children, who have English as their second language, and this creates problems. The balance is skewed, and those researchers who are not involved directly in examining sign languages largely remain ignorant of BSL.

This creates a disadvantage for Deaf pupils, as researchers persist in examining how they use English as a language of maths, and in communicating and learning in maths situations. However, sign languages are human languages (Brien, 2000), and therefore are perfectly appropriate as a medium for learning mathematics.

Brien and Brennan ('Encyclopaedia', ed. Mike Byram 2000) also confirm that sign languages are 'human languages', expressed primarily through a visual/gestural medium, using movement, handshapes, and the body for articulation. The eyes, mouth, head and shoulders, are also part of the visual expression. Research has shown that BSL uses all these articulators in the production of number concepts. Sign languages also make much use of referencing.

Sign languages sometimes refer to spatial syntax. They use the real space in front of the body, and have a highly structured way of expressing meaning. It is a misconception that signs are simple to produce. They all have a central point, and are signed in front of the body. Signs also use simultaneity, in that facial expressions and head movements can be articulated at the same time as a sign is produced. These features are essential for portraying negation, questions, and topic comment forms.

Brennan and Brien (2000) said that lip patterns are also important. Sign languages use a wide range of lip patterns that have specific meanings in the language, as well as those that are borrowed from spoken languages.

For example, the number signs ONE, TWO, THREE, all make use of the English lip patterns for the corresponding words. But, as I mentioned earlier, many Deaf users of BSL use a lip pattern that looks like 'oneth' for ONE. Other numbers are not affected, and use the borrowed English lip patterns. When teaching sign language to hearing people,

BSL tutors must show what Deaf people use in real world, and not just give perfect English lip patterns.

The sign SEVEN (a 'five' handshape on one hand and a 'V' handshape on the other – a fist with the index and middle fingers extended and spread) was used on a Deaf TV programme being presented by a Deaf person. This was an old sign for 'seven' but still acceptable, and many older Deaf people use this sign. It is only grammatical if it uses both hands. If only the 'V' handshape was used, this would be unacceptable and ungrammatical. There is also a sign SEVEN using both the 'five' handshape on one hand and the 'seven' handshape on the other, but this sign can be articulated with only one hand (the 'seven' hand). There is also a regional variation from the South of England which uses a fist with the thumb and index finger extended for SEVEN. Again, this can be signed along with the 'five' handshape on the other hand, or alone. English lip patterns are still used with these signs for numbers.

"In English, words have a definite order in a sentence. A speaker can only say one word at a time, so rules can be made about which word should come first. In BSL, as you have seen, two one-handed signs can be made at the same time, and further meanings can be added by other parts of the body simultaneously". Miles, D. (1988) British Sign Language, A Beginner's Guide, BBC. P94. English mouth patterns are borrowed and used for signs such as places, numbers, names, colours etc.

> Although BSL is independent of English, it has been influenced English, and has borrowed from English. One of the things it has borrowed is the mouth patterns from English words. BSL has not just borrowed randomly, though, and there are times when English mouth patterns are borrowed, and times when they are not.

> More importantly, BSL changes the English mouth patterns, so that when they are used, they are not always used as they are in English. (Woll & Spence 1999:81).

Examples of signs with mouth patterns are verbs such as WANT, THINK, and KNOW. Mouth patterns are used especially for proper names, e.g. of people, towns, and countries. They are also important for signs that are made up of the first fingerspelled letter of an English word, which without the mouth pattern would all look the same on the hands. Sutton-Spence and Woll (1999) give some examples of these: GEOGRAPHY, GOVERNMENT, GARAGE, GUARANTEE, GLOUCESTER, GLAMORGAN, GINGER, and GEORGE all use the fingerspelled 'g'. VIRGIN, VODKA, VEGETARIAN all use the 'v', and MOTHER, METRE, MONTH, MEMBER and MONDAY all use the 'm'.

English lip patterns are not always used with signs, for example the sentence 'What is your name?' would be signed 'NAME WHAT?' and has a compound lip pattern. 'Are you Deaf?' is similar ('DEAF YOU IX?) - the lip pattern 'deaf' is spread over the entire sentence.

Sign language is the language used by the Deaf community in the UK. It is true that deaf children tend to rely more heavily on visual systems than hearing children, but the importance of sign language as a language for learning cannot be emphasized enough. Visual aids to learning will help, but they must be used in conjunction with and constantly linked to the grammatical structure of BSL. When using cooperative maths tasks, it must be remembered that deaf and hearing children will have a slightly different approach.

Summary

Sign language is, as I have demonstrated, a true human language, which cannot be ignored. The medical profession must be challenged as to why they are ignoring a human language which has it's own linguistics and is used every day by Deaf people in the Deaf community. It will become impossible to continue to ignore or neglect to mention sign language, and impossible to continue to use fear to influence parents of deaf children into using technology and focussing on speech. There are challenges, however, for teachers working in the education of deaf children.

Videos of maths questions could be used, and students could be filmed signing their answers. Discussion in sign language with other pupils and the teacher would also be beneficial.

> Data that has been collected is ignored by the those adhering to the medical model, and the focus is rather on data collected by hearing researchers that suggest that Deaf children of hearing parents in oral or English-based signing classrooms are impulsive and distractible" (Emmorey & Lane 2000).

Society as a whole is hearing, and parents of deaf children are making the choice for them that they must try to join the hearing world as fully as possible.

Chapter 2

Deaf children's production of natural BSL with rules and structure:

Just as linguists have documented spoken languages, sign linguists (Stokoe (1965), Brennan (1992), Sutton Spence and Woll (1999), and others) have given us a full and detailed description of the language of BSL. However, many hearing researchers have only a limited understanding of how BSL functions as a language. Other researchers (Silverman-Dresner and Guilfoyle (1972) tested hundreds of 'hearing impaired' children in a wide variety of American schools to assess their language development. They found that most children did not understand words like 'if' and 'because', 'most' and 'some' until they were well above their teens. It is not clear whether they tested these children using ASL or oral English, although perhaps one can assume, by their use of the term 'hearing impaired' that they were focussed on oral education.

The term 'hearing impaired' comes from a medical model of deafness that views deafness as a physical handicap without regard for the Deaf community. Members of the Deaf community see this model as negative and prefer not to use the term 'hearing impaired.' However, without consulting with the Deaf community, hearing professionals persist in using the term, thus adhering to a medical model of deafness.

The Deaf community is labelled as a community that by definition needs medical services. Everything has a label. Every group of people that perceive themselves to have something in common, give themselves a label. Other people might also give that 'other' group label. The difference is that a group will usually give itself a positive label, and an 'outsider' group will either accept that label or give the group one of its own, this may not

be so positive or acceptable to the group so labelled. The BSL sign for the words 'hearing impaired' is also very negative. There is an underlying meaning to this sign (a slightly negative connotation, including an assumption that the hearing impaired person is not a fully fledged member of the Deaf community and probably does not sign fluently, if at all). Deaf people must ask themselves: What is the message we give the deaf children when we sign it? Does this reflect our 'unspoken', 'unsigned' aversion to using it with children? The term 'Deaf' is used for special schools in 'School for the Deaf', but the term 'hearing impaired' is used for deaf children placed in the mainstream, even though there are no 'Schools for the hearing impaired'. My feeling is that this is something to do with the twisted logic of hearing people that believe in integration. The real questions are about which labels we use and who chooses them. During informal conversations with 32 Deaf people from the local community (some in a group, and some individually), I asked about terminology. My informants were aware of the research I was involved in, and my reasons for asking the questions. Their answers are as follows:

"Which do you prefer to be called?"

Hearing impaired	0
Deaf	21
Partially Deaf	4
Other, hard of hearing	1
Total:	26

"Do you think the word Deaf should be included in the name of the education service?"

Yes: 25

No: 1

None of them preferred to call themselves 'Hearing Impaired". About 75% prefer just 'Deaf' but one chose 'hard of hearing', but the same person chose 'Deaf and hearing impaired' for the question about the education service.

It is overwhelmingly obvious even from this small sample that the term 'Hearing Impaired' has no relevance or has negative connotations for this group of people even though they are, in medical and audiological terminology, ' hearing impaired'. While they accept that they are unable to perceive sound, they do not accept being labelled 'hearing impaired'. They all preferred an identity which linked them as 'Deaf'.

Padden & Humphries (2005): p159 say "Besides the problems of agreeing who was Deaf and the problem of their language becoming public, embracing "culture" as a means of public identity meant agreeing to replace the English term "deaf" with "hearing impaired". Deaf people had always used a sign, transcribed as DEAF, which referred to themselves. The sign had been translated into English as "deaf," but it is an inaccurate translation. The English word refers to loss of hearing, but the ASL sign refers to a difficult to translate quality, the essence of what DEAF people are. The sign would be more accurately translated as "we" or "us" (Deaf people), and carries the meaning of hearing loss only secondly. Deaf people are deaf, but not solely defined by this characteristic. (This is similar to certain tribal groups' names for themselves, which translate as 'the people', such as some native American tribes).

The word 'deaf' can be used as a pertinent example. The majority of people use the word 'deaf' (with a small 'd'). However, 'Deaf' with a capital 'D' refers to the minority of the population that most hearing people would view as having a disability - the lack of hearing. But 'Deaf', and the sign DEAF, are used by the Deaf community as a positive confirmation

of a 'Deaf' identity, of belonging to a community that uses sign language (Brien, D.,(1982). pp. 350, and Collins, J (May 1997).

I support this statement by Padden & Humphries; they both are Deaf and researchers. Hearing researchers, along with educational establishments and other professionals, have been reluctant to use the term 'Deaf'. They often use the term 'hearing impaired' as a means of protecting themselves, but it does not include the Deaf community. Education authorities have been using the term 'hearing impaired' for a long time, but the Deaf community has challenged them to start using the term 'Deaf', and explained that the concept of 'impairment' is offensive to Deaf people. In the UK there are up to 10 million people in total who have some sort of hearing loss, many caused by a variety of conditions such as aging or accidents. Most of these people are not considered part of the Deaf community. There are between 60 and 70 thousand Deaf people who use British Sign Language and identify themselves as part of the Deaf community (Ladd, 2003:32-33).

So, how is it that deaf children can come to produce natural BSL with accurate adherence to it's rules and correct structures? The answer is that they need to have Deaf adults as role models throughout their language development – from the time they are young babies, through to secondary school. Deaf adults also provide positive cultural role models for deaf children.

With parental understanding and support, Deaf adults who work as professionals can visit their home lives with the acceptance and cooperation of hearing educators, children can experience regular interaction with Deaf adults in school. Deaf people need to be active participants not only in education but in research too.

Results of research conducted by hearing researchers on 'hearing impaired' children are often not clear. This is due to oral education methods. It is not clear from the results whether these pupils have an understanding of the concepts mentioned earlier ('if', 'because', 'some', 'most'). It is perfectly plausible that the children understand these *concepts* but simply are unable to express them in spoken English.

Mathematics Education:

"Psychologists investigate whether there is a causal connection between two human characteristics in this case, deafness and mathematics difficulty ... if deafness causes mathematics difficulty, the level of hearing loss should be related to the level of difficulty." (Nunes 2002:) p8. Psychologists who are usually if not always hearing professionals, tend to focus on 'hearing loss' in their investigations, and relate this to levels of difficulty. I believe that, if research was carried out with a full understanding of sign language and language acquisition and development, rather than based on the medical model of deafness, it would provide proof that difficulty with learning mathematics and deafness are *not* in a causal relationship.

Discussions with bilingual coordinators about the using of BSL in the maths education for the deaf children about the best way to give deaf children an understanding of mathematics concepts have raised issues such as the standardisation of signs, the vocabulary required for maths, and regional variation in BSL. Each Deaf school will use signs that are suited to the regional variety of their area. But discussions about specialist mathematics vocabulary have brought up issues of how signs can be adapted to aid ease of understanding for deaf children. Such discussions are ongoing, and raised many issues (that not all teachers agree on) about the best way to teach deaf children maths concepts.

I must also consider aspects of the early experience deaf children have with numbers in relation to language, and activities in schools related to maths and numbers. Children's early experience is interesting to consider because it will affect their knowledge and skills with mathematics later. Children bring this knowledge and these skills with them when they come to school.

> Although deaf children live in the same sort of housing and home environment as hearing children do, there seem to be major differences in the circumstances where language is used. While hearing families use mealtimes and bath-times as major opportunities for spoken language play and interaction, these seem less important to deaf families. One has to understand that a sign interaction has to take place in a visual context and where there is a competing visual task – such as eating – the extent of language produced by parent and child drops. The most common interaction situation was book-reading. Although this also occurs for hearing children, it is proportionately less frequent in random recordings in the home. The fact that book-reading is a highly regulated context, where divided attention may be easier to practise, is of some significance and deaf mothers seem to be comfortable with this task. In this situation, there is also the effect for the mother of being able to introduce vocabulary and simple grammatical constructions. The child tends to seek opportunities for naming. Kyle, J. & Ackerman, J. (1998) p7. Deaf children Developing Sign. Bristol University.

For the deaf child, the home is often a hearing environment. Here, deaf children are developing maths knowledge and language from an early age, and this is developing every day. When they start in the education system, however, there are specific linguistic demands placed on them in relation to maths. This begins at infant education and goes through to secondary education. Some children only just survive this, while others, with

good language skills, achieve reasonably well. The concern, however, is that children are developing language while at school, but for those with hearing families, this development is not being reinforced at home, where they are not included in the everyday spoken language conversations.

Deaf children of Deaf parents, who sign to them from the time they are born, learn sign language as ably as hearing children learn oral language. Goldin-Meadow (2003) in Nunes T. (2004:7). In relation to this quote, I question the use of the word 'learn' when talking about deaf children gaining sign language from their Deaf parents, and suggest that 'acquire' would be more appropriate in this context. Learning relates more to something that is taught in a school, whereas a first language in the home and family context is 'acquired.'

> ...for normally developing children, language acquisition is a robust process which fails only in cases of extreme deprivation, as there is normally far more relevant and useful language input than is needed to trigger the processes of language acquisition. However, for infants with a severe to profound hearing loss, this is usually not the case, and ensuring that they experience enough language to activate their natural language acquisition processes can be a problem. Gallaway, in Gregory et al.,1998: 49.

It has been established that children's language acquisition starts with hearing the mother's speech. Basic vocabulary is established and emphasized by the mother's repetition of these words until the child repeats them themselves. This is the same with number words, for example the words 'one, two, three and four' which are used with regularity everyday in the mother's speech. Repetition and everyday use of these words helps the child to learn them. It is the same for other uses of numbers – 'one year old, two

years old' and so on are often used, as well as phrases like 'it's time for bed', or Daddy's home from work', or we're going to a party' used in conjunction with numbers to indicate time. This is the early stage of children's numeracy development. Hearing children in hearing family environments pick up number sequences in this way as well.

Much of our knowledge about the way children learn numbers is gathered from studying what children say. Parents and children in conversations frequently refer to many popular numbers, for example in songs, stories and other activities. It has been well established by research findings that in language acquisition, it is the mother's speech that emphasizes the basics in this area for their children.

> Hearing children hear mathematical talk almost from birth, 'wait a minute', 'that's too small for you now', 'it's miles away'. Most hearing children are also involved in mathematical talk themselves from early on, of which counting is a primary example. Durkin *et al.* (1986) in their review of the literature suggest that hearing children can produce a numbers word sequence at two years of age and by three years of age have some ability to discriminate acceptable and unacceptable counting by others. Gregory (1998): 123.

The number words one, two, three and four were the most frequently used and repeated. These basic elements are repeated most during children's early stages of language and numeracy development, and this is how children come to know the sequence of numbers eg: 'one, then next is two, then next is three, and next is four.' This kind of early teaching gives children an advantage, but also poses a problem for deaf children in hearing families who do not have access to the everyday spoken language used in the home. In this way Deaf children with Deaf parents have the same advantage as hearing children with hearing parents, but deaf children with hearing parents form a disadvantaged group.

90% of deaf children have hearing parents, and diagnosis of deafness in children has tended to occur quite late, so it is the majority of deaf children who have a delay in language acquisition. "The general finding of many, many studies is that Deaf children of Deaf parents acquire sign language in the same way that hearing children of hearing parents acquire spoken language. Both groups of children pass through the same developmental stages at about the same time and make the same sorts of errors". Emmorey K. (2002:169)

This kind of early teaching might give these children an advantage, but it also might not, but in any case deaf children's acquisition of language and early numeracy is very different. Deaf children who are born deaf do not receive the same input as hearing children. Parents may speak to their deaf child, but the child does not hear. Parents may not even know their child is deaf at this stage. Late diagnosis is very common, and there is little communication getting through before diagnosis.

It is no different, of course, for Deaf parents of Deaf children. They start signing with their child straight away, and the early learning experiences in this situation work in exactly the same way as they do for hearing parents of hearing children. The process works naturally. For deaf children with hearing parents, however, the process of repetition of spoken words, and the child repeating them back, does not function. These children need input in sign language.

Bellugi & Kilma's research has found that the Deaf person is the expert when it comes to sign language and Deaf culture, not a victim of hearing impairment. It is important to recognise that a number of the Deaf researchers who have worked in the lab have gone on to earn graduate degrees, including doctorate degrees. Therefore, Bellugi & Kilma have directly contributed to the education of many of today's top Deaf researchers. It is

easy for hearing researchers to miss a lot of what is going on. Deaf people themselves have the expertise and the 'sharpness' to catch exactly what is happening.

Durkin and Shire (1991) have similar concerns about the early mathematics experience of deaf children. They list three different "linguistic handicaps". The first is deafness, the second is dyslexia, and the third is language disorder.

Barham and Bishop (1991) have reviewed the research into hearing impairment and mathematic performance. They report that 'initial impaired children' are delayed in their learning, and that deaf children regularly under-achieve in that area of their education. They claim the reason for this is "ambiguous language", although they add that some children have additional difficulties.

Difficulties with content depend on what kind of maths instruction a child receives. Explanations by teachers may suit the child's needs, or may not be suitable for that individual child.

This demonstrates the lack of language and numeracy acquisition experienced by deaf children of hearing parents, because of the absence of BSL in the home environment. There is a distinct paucity of parental input at this early and important stage. Hearing parents who sign, or who might be learning sign in a local sign language class, will be able to do better in this respect.

This contrasts with the natural acquisition of these skills at home that Deaf children of Deaf parents are exposed to before they start at school.

Barham and Bishop do not mention BSL, or deaf children that use BSL, in their research. Likewise, Durkin and Shire's naming of three "linguistic handicaps" appears to label deafness as a disability. My view, once again, is that this focus on spoken language discriminates against deaf children by labelling them as "impaired". Deaf children who use BSL from an early age are not necessarily at a disadvantage to hearing children, and are able to develop at a "normal" rate, but the research persistently ignores this.

They claim that the language used is ambiguous because these children have additional areas of difficulty. Difficulty with context depends on what kind of maths instruction the child receives. Does the explanation given by the teacher suit the child's needs, or not? Is it something the teacher is doing that makes it look like the child's language is delayed? Or is there some other reason? There is a lack of language and numeracy experience for deaf children with hearing parents, and this causes problems, because they are missing BSL in the home environment. Early input from parents is an important stage, and this stage is missing. Hearing parents who do sign or who are learning language in local sign language classes may be able to do better for their children. Those parents who only communicate with their deaf child in spoken language cannot provide this. Thus, the child becomes labelled as having 'language delay' or a 'language disorder' but it is not always clear what these label really mean.

This contrasts with natural acquisition, by Deaf children who have Deaf parents who expose them to sign language early, before they start school. Where they start in school they already have a solid language base on which to build. The fact that this group has been ignored by hearing researchers who have no knowledge of sign language or who have not worked with alongside Deaf researchers meant that deaf children's development has been wrongly labelled as failing or delayed. My argument is that the failure is actually on the part of the researchers. Even when they have included deaf children with hearing

parents and Deaf children with Deaf parents in their research groups, the methods they have used for testing these children, based on spoken language, have resulted in them being incorrectly classed as failures or as having delays. The use of the term 'hearing impaired' for all the children has also masked the variety of backgrounds of the children involved.

I want to emphasize that I will not be using the term "hearing impaired" in this research. "Deaf" refers to people who are users of sign language and there is an element of pride in this term. "Hearing impaired" people are not seen as members of the Deaf community. However, most of the research that has been carried out in this area uses the term 'hearing impaired' freely, but does not state whether this includes sign language users or not, which confuses the issues. Hearing people have chosen to use "hearing impaired" to describe deaf children but I do not agree with this choice. Using the term "deaf children" would be much clearer.

> When asked about the problems their pupils are having with mathematics, teachers of deaf children seem to have an intuitive feeling that language is at the heart of their difficulties. Certainly, one has only to hear deaf children speak, or examine their written work, to recognize some of the effects of hearing impairment, and despite what has been said about the use of figural and symbolic material in mathematics, it is nevertheless a school subject which involves a considerable use of language, often in ways not helpful to any language-impaired child. Barham, J. & Bishop, A. (1991) Mathematics and the deaf child. P179.

This brings us to another problem – the labelling of deaf children as 'hearing impaired' or 'language impaired' by hearing professionals who have not worked with or listened to the views of Deaf professionals about the definition of 'impairment' as it is linked to hearing

levels or language. Hearing professionals tend to miss the fact that deaf children use sign language. It is often stated that there are many problems with learning mathematics, both linguistic and communication problems, and they can occur at any level. Obviously, the use of BSL would solve some of these problems. Language knowledge is traditionally taught face to face or by texts. The use of other media should be considered, for example, TV programmes or magazines can provide many experiences of using numbers. Maths can be linked into other specialised subjects so children are talking and reading about maths with their teachers in a variety of situations.

In primary schools, deaf children can easily come to understand the concepts of 'most' and 'least', for example, if signs are used. The visual nature of some signs gives them clues as to the meanings. (For example, MOST can be signed with spread hands, palms facing each other, then the hands move apart to indicate something larger is between them. LEAST is signed with hands apart, facing each other, with two fingers extended from a fist ('H' handshape). They move downwards and together to indicate the space between them is diminishing).

Signs can be adapted not to give extra visual information to do with size and so on. The BSL/English dictionary lists such 'alternative signs'. (For example, MOST is usually signed with two index fingers, both pointing away from the body, one in front of the other. They are then rubbed once along each other to finish with the other hand in front. This is more of an abstract sign that doesn't contain any information about size. LEAST creates more of a problem - there is no alternative to the sign described above, but it can be inflected to make the movement much more subtle, or a different handshape used (thumbs instead of the 'H' handshape) in an attempt to avoid giving away information about its meaning. This would depend on the context in which it was being used. This is

only a problem when teachers want to test understanding of the English word 'least' meaning is a mathematical concept at base.

This is the same with the sign LEAST. It can be signed in a way that indicates something is getting much smaller, but needs to be modified to use only a very small movement in space, so as to not give away the meaning. Signs can be adapted so that their visual nature does not give children clues as to their meaning. The alternative sign for MOST is listed in the BSL/English dictionary, but there is no alternative sign for LEAST, so it has to be adapted to be less visual and a little more abstract.

Which sign is used will depend on the context. Sometimes, one could fingerspell instead of sign a concept like 'least.' But fingerspellings are English words; so once again, it would depend on the context. The only problem is when a teacher wants to test the understanding of English words, the word can be fingerspelt, but this does not give the basic concept of something being the 'least,' so it might need to be alternated with the adapted sign LEAST. This will be discussed further in Chapter 7.

I'd suggest a hypothetical situation. If the question is asked: "What is 8 x 9?" How can this be answered? It can be answered by using the fingers. If both hands are held up, with all fingers extended, and eight fingers are counted off left to right, the middle finger of the right hand represents '8'. If this finger is bent down, you are left with seven fingers to the left of the bent finger, and two fingers to the right of it. This gives the answer to the question – '72'. To solve '6 x 9 = ?', the same method can be used. The finger sixth from the left is bent down, and you are left with five fingers to the left of it, and four to the right of it, giving the answer '54'.

This method was shown by me by a Deaf teacher. Hearing teachers could learn methods like this and use them with their deaf pupils learning their 9 x tables (it could also be used to teach hearing children).

> Most hearing people who have attended school will have memorized this number fact. They know the verbal string 'eight times nine', seventy-two'. The fact that we know the answer to this problem as a memorized verbal string is seen as compelling evidence that oral language is an integral part of our knowledge of mathematics. This could lead us to think that deaf children have some difficulty in learning mathematical because they find it hard to memorize verbal strings. Nunes (2002) p10.

It is hard for deaf children to memorize things using an oral language method. It is a fact that the use of the oral method will fail deaf children in their education. I remember my own maths classes at school. We had an oral teacher at first, and I could not understand any of the lessons. I had to use a Deaf friend in class as an interpreter, and we all stared hard at the numbers on the blackboard until our eyes were sore. Finally, this teacher was replaced by a Deaf teacher, who showed us how to work out maths problems. He also gave us a rhythm to help us count and to remember verbal strings. Nunes mentions the need for a strategy like this in teaching deaf children, but neglects to examine how Deaf people have learned in classrooms using sign language. The teachers Nunes observes are hearing teachers, who do not use BSL. I contest that her research is not wide enough to provide a true analysis of how deaf children learn mathematics. There has been no research on how children taught by a Deaf teacher can be taught to memorize verbal strings.

In summary, I believe that other research has been skewed by the fact that it has been conducted by hearing researchers who do not look at fluency in sign language, and do not choose deaf children who are fluent signers to be included in their research. If the research has found that most deaf pupils do not understand the concepts of 'if,' 'most,' 'because', and 'some' until they are teenagers, this is of huge concern, especially if these concepts are a problem for a large number of pupils. But, it is still unclear as to how the researchers can claim such results when they have not had Deaf researchers (or hearing researchers who are fluent in BSL) involved in their research. The research displays a complete lack of awareness of sign language. The methods used in the research are often not explained, but if they are oral methods, they will serve to confuse deaf pupils, and if signs are used it needs to be explained which signs were chosen and why. It is often mentioned that video was used because sign language is a visual language with no written form, but no further explanations as to the methods of investigation are given.

In addition, the use of the term 'hearing impaired' in this research is of great concern. The term is very broad, and often no clarification is offered as to the level of hearing loss of each research subject. The terms 'Deaf' and 'BSL User' are not used by these researchers, but it is extremely important to know if a child being studied is a Deaf, a user of BSL, comes from a Deaf family, and how their acquisition of language is progressing. If a child has hearing parents that is also important background knowledge, but this kind of information is never stated in the research. The blanket term 'hearing impaired' masks all the important variables such as whether the child uses BSL, what level of hearing loss they have, and whether they have a language advantage or delayed language development.

Chapter 3

Using BSL in the classroom:

The aim of this chapter is to look at the use of BSL in the classroom. I have had many years experience as a pupil in a deaf school and also working in classrooms with deaf children, observing them learning mathematics and other subjects. It is important for me to discuss issues raised from this experience here.

As a pupil in a deaf school, I had one Deaf teacher of the deaf who taught me mathematics and science using sign language. From him I learnt about how to talk about numbers and science topics in sign language. These skills were useful to me in my teaching of deaf children in primary and middle school learning mathematics and science and using BSL, and were also useful in doing translations of assessment questions from English to BSL.

Hearing teachers believe deaf children have particular difficulty learning mathematics.

Most teachers of deaf children, at both primary and secondary level, would agree that mathematics is one subject with which their pupils find special difficulty. Barham, J. & Bishop, A. 1991:179.

When asked about the problems their pupils are having with mathematics teachers of deaf children seem to have an intuitive feeling that language is at the heart of their difficulties. Barham, J. & Bishop, A. 1991:180

My personal response to this is one of anger, as I am convinced that these researchers and teachers are not using BSL to communicate with the children and are failing to understand them. Often the focus has been on measuring the level of hearing loss of deaf pupils, as it is suspected that deaf children cannot be taught well because they do not hear sounds and that pupils with better hearing levels achieve better than profoundly deaf pupils. This has been shown not to be the case by researchers who use the same focus of research. (see Gregory, S. 1998 p120).

However, experience has taught me that deaf children can understand and express themselves brilliantly in BSL, but this is too often missed by hearing people who do not have a good enough understanding of BSL to be able to see it. Thus deaf pupils are labelled as lagging behind in subjects like mathematics when potentially they are not.

> By now you must be wondering whether deaf children have difficulties in mathematics exactly because they are deaf. Some people argue that mathematics is a form of language and, because learning languages is difficult for deaf pupils, they find learning mathematics difficult. This argument would see a direct, and thus inevitable, connection between deafness and mathematics learning difficulty. Is this argument sound? What evidence is there to support this idea of a direct causal connection between deafness and difficulty in learning mathematics? Nunes, T. (2004) p6. Teaching Mathematic to Deaf Children.

This view by held by some hearing researchers and teachers is due to them being naïve about sign language. The Deaf teacher who taught me at school was a qualified teacher of the deaf, but had had to fight a long battle to achieve that status. He had been oppressed by hearing teachers who told him that he couldn't be a teacher of mathematics and science because it would be too difficult for him. Like me, he was a child of Deaf

parents. I was also told that I could not work in classrooms with deaf children because I would not be able to role model good spoken language for the deaf children. Determination to become a teacher led me to work in nursery school with a deaf boy (see A Language For Ben – A Deaf Child Right to Sign, Fletcher, L. 1987), and also at Leeds Deaf/Hearing Impaired mainstream school and at a Deaf college. Now I am a Lecturer at a University in sign language and linguistics. This is quite different from hearing people's original expectations that I should be role modelling spoken language in schools and higher education.

> One of the most important results of sign linguistics studies over the last 30 years has been to demonstrate to everyone (who cares to look) that BSL is a language just as good as English, or any other language. This is important because more powerful people have thought that BSL is not a language at all, so it has not been used in many settings, including schools, churches, or on television, and deaf people have suffered by having their language ignored or insulted. Sutton-Spence, R. & Woll, B. (1999) p9. The Linguistics of British Sign Language.

This belief that BSL is not a language at all has been pervasive in education over many years, and had a significant influence on teacher of the deaf training. Oral skills were stressed as the most important skills to be taught in deaf education. BSL was passed on to deaf children in schools mainly by those children who had deaf parents. I have personal experience of this phenomenon: I remember when my parents took me to school every two weeks after our fortnightly weekend visit home, or after a holiday, or came to a sports day. Deaf children would rush up to meet my parents and chatter to them in BSL, because at their homes, with hearing parents, they couldn't do this.

Deaf children of deaf parents, who sign to them form the time they are born learn sign language as ably as hearing children learn oral language. Nunes comments on the lack of appropriate language input for the majority of Deaf children:

> The misconception that learning languages is difficult for deaf children comes from the fact that most deaf children – about 90% - are born to hearing parents, who do not know a signed language. Therefore there is a mismatch between the parents' knowledge and the children's language learning ability. The parents' input of a spoken language, which the child cannot receive, is as much beyond the reach of the deaf child as ultra-sounds are to the human ear. The mismatch often continues for a long time, as many parents do not find out that their child does not show the expected production of spoken words. And when they find out, they would themselves need time to learn sign language, if this is the type of education they choose for their child. Nunes, T. (2004) p7.

Deaf children acquire BSL from Deaf adults, and their Deaf parents, and bring their language to their schools. For this reason it is imperative that Deaf adults are brought into schools. Deaf children will learn maths more in schools rather than at home. This is because they do not have a signing environment at home. Those Deaf pupils who have Deaf parents have an advantage, because they communicate in sign with their families at home. Deaf parents can explain things at home, like counting, talking about the time, routines like bedtime, dinner time, sitting with family or friends, what time people get home from work, cup of tea time, and parties. They can look at the clock to tell the time. They can discuss the ages of people, how many people will be coming for tea, what time they need to get up and get ready for school, what time people get home, and so on. There are many opportunities to discuss topics that include numbers.

However, those children without a signing environment in their homes will not have this opportunity. In school, though, they will be mixing with children who do have Deaf parents, or have access to Deaf adults, and will acquire the language to talk about maths that way. This is really important for them.

> Hearing mothers with Deaf children may experience more difficulty modifying their signing and getting the visual attention of their Deaf babies, perhaps because their own communicative experiences affect their spontaneous interactional strategies (Koester, Karkowski, & Traci, 1998; Waxham & Spencer, 1998). In K. Emmorey 2002.

Unfortunately, only about 10% of Deaf children have Deaf parents. The early exposure of sign languages available to Deaf children born to Deaf parents provides them with the tools necessary to play pretend games, tell creative stories, label objects in the world, question, and make themselves understood. (Bellugi & Klima 2002).

In the past, at Deaf residential schools in the UK, children of both Deaf and hearing parents attended. This allowed those with hearing parents to learn from older deaf pupils such as teenagers in the school, and also Deaf adults. During the course of the 20th Century, most of these residential schools were closed down. Small deaf children are now placed in mainstream schools and only some of these schools employ Deaf adults to work as support tutors and to provide BSL input.

Closure of residential schools for the Deaf under the Government's aim to mainstream pupils with special educational needs meant that the 90% of Deaf children with hearing parents lost access to a signing environment and exposure to the sign language of peers and Deaf adults. This situation has begun to be addressed in recent years with

mainstream schools starting to employ Deaf adults to work in various roles ('teaching assistant', 'Deaf instructor', 'support tutor', 'classroom assistant') who function as language models.

However, for the 90% of Deaf children who have hearing parents the combination of home environment and mainstreaming means their world is often one of delayed and impoverished language input and limited interaction with nonsigning parents and peers. In these children, one can see clearly the symbiotic relation between language, social, and cognitive development disrupted. (see Bellugi & Kilma 2002).

These issues have led me to other concerns. If we teach mathematics and numeracy to children, in the ways we are doing it today, what about tomorrow's world? We need to know much more about how children learn maths, and how maths learning can be linked to how they think. As society changes, so do concepts about numeracy and literacy. Nunes and Bryant (1996) have said, "The concept of literacy has clearly changed, and continues to change over time. Since 1880, when sign language was banned in education, different Deaf schools have used different dialectical signs for numbers and numeracy as they are used in everyday life and jobs. How do we teach Deaf children about number in the full sense of the word? How do we create a school environment where they will learn about numbers and numeracy? We need a mathematical way of thinking about how we think about numbers. Clearly, we need to think about how children learn maths and the more complicated mathematical processes.

How then do we teach deaf children to be numerate in the full sense of the word? How do we create school environments in which they not only about numbers and arithmetic but also think in mathematic ways? When it comes to teaching mathematics, it is clear then that we must consider both how children learn about numbers and arithmetic operations

and also how they come to think mathematically in ways that are progressively more complex.

This means Deaf children are learning maths concepts everyday in schools. They are talking about maths in sign with Deaf adults and creating new signs where necessary. Some of them have Deaf teachers teaching them maths, which means children can learn clearly. But, if they do not have a signing environment around them, they will have trouble developing a way of thinking about complex maths concepts like time and numbers. This is different to Deaf children who have Deaf parents, who have a significant advantage over those without Deaf parents.

The little research that has been carried out in this area has mostly been by hearing researchers focussing on problems with teaching mathematics to deaf children. There has not been much exploration of numbers in BSL. Often these researchers say that deaf children fall behind in mathematics because they are taught using the oral method, or because their parents or teachers don't use sign language. For this reason, it is imperative to have Deaf adults working in educational settings as role models and to provide a positive influence on deaf children and their parents. Research looking at sign language is often carried out by hearing linguists who have knowledge about sign language and may have skills in BSL but are often second language users of BSL. Usually these researchers for whom BSL is a second language do not recruit signers from the Deaf community or Deaf education to be involved. However, hearing people always ask Deaf adults to clarify meanings or to pick out details, and this is even the case when looking at the language of small deaf children who have BSL as their first language. This was one of my tasks in my previous work in education (with both deaf children and adults) – to work with hearing colleagues because when they look at sign language, they often

miss out special structures or lexical aspects, as well as facial expressions and non-manual features.

At this point it is relevant to bring some of my own experience, as laid out in my paper published in LASER (Language of Sign as an Education Resources) 1988 which was presented at a conference "Deaf Adults Working in Education". I have worked in many different schools, both deaf and hearing schools, with a wide variety of teachers. I also worked with ethnic minorities in a primary school in Leeds. The teachers I have worked with range from those who are:

a) unqualified teachers of the deaf

b) B.A.T.O.D (British Association Teachers of Deaf) trained teachers of the deaf

c) non-BATOD trained teachers of deaf.

In a college for the deaf, I worked with a similar variety of trained staff.

I found that all these teachers were very different and displayed a variety of good and poor attitudes towards the Deaf. Some of them were easy to get along with, and others were not sure how to treat me. Some were accepting of Deaf adults as equal partners and worked alongside me, while others felt threatened. Some were good at teamwork. Some, over the time I worked with them, were able to change their attitude towards Deaf people and learned to accept that Deaf people could work in positions of responsibility. Sadly, some were not able to make these adjustments.

I will give some examples of why it is important that schools should have more Deaf professionals in education using BSL. Deaf professionals need to be involved across the

whole of the age range, from pre school children to 16 years olds and post 16 in education. These are examples from my own observations and experiences.

Example 1: A boy of seven years was working at understanding the concept of 'more'. He had to point at groups of objects to show the teacher which group had 'more'. The way he pointed made it very clear to me that he was not sure of the answers, but the hearing teacher couldn't see this. He was pointing with the palm of his hand, so that it wasn't clear which group of objects he was actually pointing at. This made it obvious to me that he did not understand the concept of more, and was trying to find a clever way to disguise this. The hearing teacher thought he was getting the answers right. I told him to be clear and to point with his index finger.

Example 2: I asked a nine year old boy in BSL what the sum of four plus six was. He answered 'five'. The sign SIX in BSL is a handshape with a closed fist with one digit held up (either the little finger or the thumb, depending on regional variation). It is hard to imagine how this had happened, but this boy of nine thought either of variations of the sign SIX meant 'one' (the ONE handshape is a closed fist with the forefinger held up). He thought that any handshape with one finger held up meant 'one'. This boy had been taught by hearing teachers using both sign language and the oral method. One oral teacher in the past had used a handshape with the thumb held up to mean 'one' when counting with this pupil. He was very confused about counting using the fingers until I came to work with him, and could explain the different meanings of these handshapes. It was extremely difficult to work with this boy. I had to take him right back to basics and 'undo' a lot of the work the hearing teachers had done with him to correct their mistakes.

Example 3: When observing hearing teachers who use signs, but at the same time as they are speaking English, I have often seen pupils look to a Deaf adult for explanations in

BSL. They have not understood the signing of the hearing teacher. If no Deaf adult is available, children rely on each other, and ask each other what the teacher has said. This means children regularly have to work as 'interpreters' for each other. When teachers sign and speak at the same time, the languages get mixed together. Facial expressions are lost and the grammar of the two languages does not match up. Sign language is not based on sound. Teachers choose to ignore this fact because they think English input is a more important part of language teaching in schools. They also used Signed English as a teaching tool. Signed English is not often used in everyday communication, and although deaf children may understand it, they do not reproduce it when they communicate with other deaf children in the playground.

Example 4: Small deaf children use a lot of facial expressions. They give a lot of information through their features with movements of their eyes, noses and brows.

> The signer may use non-manual question markers such as furrowed brows and hunched shoulders or raised eyebrows and open mouth to indicate a questioning attitude. Similarly, the signer may use the negative headshake without any additional manual sign. Most of these non-manual signs seem to have an interactional function: they rarely, if ever, occur as content words. Brennan, M. (1992) The Visual World of BSL: An Introduction p32.

Children ask questions with their faces ('whom', 'what' etc). In BSL questions can sometimes be asked without any hand movements, simply by using a special facial expression. Hearing people aren't aware of these subtleties. Deaf adults, watching deaf children, can understand what they mean and know how to assess their conversational skills. They know if the child does or doesn't understand. They can see a subtle body movement in a backwards direction which indicates that a child has not understood. How

can hearing people, who do not see these subtleties, assess these children? There is a paucity of research into how deaf children are assessed, and the skills of native users of BSL in assessing deaf children have not been made use of when research is carried out.

Example 5: I observed a four year old boy telling his hearing teacher he wanted his coat. His sign COAT was not very clear because he was very young. He signed COAT with both fists going to his chest then moving a little, down to his stomach. Because the sign was articulated quite low against his body, his teacher thought he wanted to go to the toilet. He repeated his sign COAT but still the teacher did not understand. I was able to intervene and explain to the teacher that he wanted his coat. This is another example of why it is important that Deaf adults are employed to work with hearing teachers to tell them what the deaf children are saying.

Example 6: This particular incident occurred with a trainee teacher, although this happens to many experienced teachers also. The teacher was explaining something using words and pictures. She asked the child if he understood. The child nodded 'yes'. I knew he did not understand but the teacher didn't know this. The child knew it was easy to nod 'yes' and get away with it. I asked the child 'are you sure?' and 'can you tell me what the teacher says?' The child told me that he didn't understand what the teacher was saying.

Example 7: One of the Asian pupils I worked with signed that his dad's moustache was BIG using the base sign BIG. Because I was there as a Deaf adult with BSL as my first language I was able to demonstrate how the concept of a 'big moustache' is signed the was the Deaf adult community would sign it (BSL has the concept 'big' but it is not always signed as a separate lexical item). With this same pupil, another Deaf adult was able to correct the handshape he used when signing WASHING MACHINE (with a flat hand rather than with one finger). The same pupil would call his uncle 'daddy'. He signed

DADDY repeatedly, and I was able to check with him why he was referring to more than one 'daddy'. He wasn't able to explain, so I asked his mother via the bilingual tutor. She explained in Punjabi that in their language, there is no word for 'auntie' or 'uncle', and they simply use 'mummy' and 'daddy' to refer to all these relations.

Example 8: I worked in a classroom with a teacher of the deaf who was a skilled signer (not BATOD trained). The teacher signed to the students but she could see they did not understand (many teachers do not have the skills to see this). She asked me to sign in a variety of BSL that they could understand.

Example 9: When teaching reading in BSL it is especially important to be aware of the context. For example, the sign STOP would be signed differently in all these contexts: 'the postman stopped', 'the van stopped', 'he shouted "Stop!"'. I asked teachers how they would sign these. Most were heavily influenced by English and not skilled enough in BSL to know how to sign these different variations of STOP. They signed them all using the same sign. I always made sure hearing teachers were aware of how to sign 'STOP' in different contexts before teaching deaf children, otherwise the deaf children will pick up these contextual errors from their teachers.

Another time I observed a boy reading. He was a confident signer when talking to Deaf adults, but was not so confident when signing with his hearing teachers. He signed the written text 'Fiona went back to school', but missed out the sign WENT-BACK. I knew from previous work with this boy that he knew this sign, and also that he could understand the story. He had simply lost confidence in his own ability to sign from a written text when signing in front of a hearing teacher.

Example 10: I observed a teacher who was unqualified and also had not yet achieved the CACDP (Council for the Advancement of Communication with Deaf People) Level 1 in BSL. This teacher was using flashcards with the words 'small', 'smallest', 'big', 'biggest', 'little', and 'light'. When it came to 'light', she used the same sign to talk about a light colour, daylight, and a light weight, with no use of the different signs that for LIGHT that would be used for these contexts in BSL. The deaf children copied her and she told them they were all doing good work. I had to intervene, and check whether the deaf children had understood the different concepts, and ask them to explain them to me in sign language.

English words such as those on the flashcards must be expressed in different ways in BSL depending on the context. BIG and SMALL would be signed very differently if one was talking about a BIG CAR / SMALL CAR, or a BIG POLICEMAN / SMALL POLICEMAN. LIGHT would be signed differently in LIGHT BLUE and A LIGHT CAR. (There will be more discussion about how context affects the signs BIGGEST and SMALLEST in chapter 7.)

In this situation, I also observed the teacher praising the children for incorrect signs. For example, she held up the flashcard 'day'. A child responded with the fingerspelled letter 'd', and was praised. Again, I intervened, and it became clear the child did not understand the concept. I was able to give him the sign DAY, and explain. This happened again with the words 'orange', and 'dog'. A fingerspelled letter as a response does not indicate that a child understands the meaning of a word. Hearing teachers often do not pick up on this.

Hearing teachers who have learnt BSL as a second language simply do not have the depth of knowledge about BSL to be able to teach using BSL effectively, and will not be able to identify subtle differences in the way children sign that can affect meaning.

> The significant handshapes of BSL are those which bring about a change in meaning. The main body of the dictionary distinguishes fifty-seven separate, contrastive handshape configurations, which we can technically describe as handshape phonemes or cheremes. Brennan, M. (1999) Visual World of BSL: An Introduction p19.

Another issue is that deaf children sometimes do not articulate BSL handshapes very clearly when signing. Hearing teachers, for whom BSL may be a second or third language, often do not see this, and so do not alert the child to their mistake. Deaf adults are more likely to pick up on these phonetical (or 'cheretical') errors and can give the child the correct handshape, palm orientation, movement, and location, and can also show this to the hearing teachers. This is an important part of education, just as hearing teachers of hearing children would naturally correct errors in their speech, and repeat a word for them clearly so they can hear it said correctly.

When I worked in Leeds we used video to analyse the communication of deaf children. We videoed each child in various situations: one to one with a Deaf adult, one to one with a hearing adult, in a group of deaf children with a deaf adult, and in a group of deaf children with a hearing adult. This technique is called 'discourse analysis'. Then we had to develop a method of transcribing the videoed BSL in a discourse code. We did this every year to follow the children's development of BSL in the classroom. It was very interesting work. We could see differences in the child's communication depending on whether the participants were all D/deaf or mixed D/deaf and hearing. Hearing teachers found it helpful to see themselves on video communicating with deaf children and this helped them to improve their BSL and their turn-taking in BSL conversations.

We also videoed hearing parents talking with their deaf children. Part of the project resulted in a Family Support Group being established. Deaf adults taught BSL to the parents so that they could communicate with their deaf children when they came home from school, needed help with their homework, and during weekend activities and holiday times. The parents found this very helpful and found they got on better with their deaf children when their signing skills improved. One of my roles was to work with an Asian Family Support Group. The parents reported that their communication and cooperation with their children was greatly improved as a result of this support. Some of the mothers could not speak any English, but learning BSL helped them to communicate more effectively with their deaf children. This project was a great success, and again shows the great need for Deaf adults to work in liaison roles in schools.

> When hearing parents raise deaf children it is important that they value being deaf positively and use that as a starting point for all their pedagogical decisions and actions. This holds that they consider the specific process of embodiment and the existence of their child as they are and focus on what their child can do, It is true that hearing parents often do not know what to do with their deaf child or how to do it. For this, they can seek advice from Deaf professionals and support from the Deaf community where possible. C. Tijsseling (2005) p37 Deaf Worlds vol 21) Issue 1.

Currently in Leeds, the Deaf/Hearing Impaired Services provide Deaf professionals to support hearing parents of deaf children. Their role is encourage and develop the rapport between children and their parents both at home and at school, and to support deaf children in developing their BSL. Deaf adults know how to encourage a child's language development by giving them the correct handshape if the child's handshape is wrong or awkward. Deaf adults use lots of phatics to encourage a child to sign more and to show

the child they are interested in what they are talking about. This relaxes the child and enhances their confidence.

Often, hearing adults tend to ask a child too many questions, such as 'Who?', 'What happened?', and so on. The child may not understand the sign or the concept of 'who', and if so one needs to be more specific by asking 'Was it a man or a woman?', 'Was it a boy or a girl?', 'Was it mummy or daddy?'. If a child doesn't understand the concept 'when', or of words for time, these can be asked about in a different way in BSL. For example, 'tomorrow' can be signed SLEEP ONE NIGHT and 'next week' could be adjusted to SLEEP 1, SLEEP 2, SLEEP 3, SLEEP 4, SLEEP 5 (counting the days). The question 'how (did they get there)?' could be circumnavigated by signing CAR, WALK, BICYCLE etc. A Deaf adult may use humour to capture the children's interest, such as THEY WALK? CAR? BICYCLE? YOU THINK MAYBE FALL OVER? (the children may respond by acting out someone falling over). Deaf adults can work with hearing teachers and advise them on how to work with children who don't understand a question.

Hearing teachers often try to sign HE and SHE, by trying to create a compound sign out of the signs MAN and WOMAN and pointing, and adding the lip pattern 'he' and 'she'. In BSL 'he' and 'she' are not necessary because the person's gender is set up in the first instance, and then they are referred to simply by pointing, as in 'WOMAN, IX', and can be referred to again and again without re-establishing that they are female. No lip pattern is used when referring to the person.

> BSL does not distinguish between 'he' and 'she', but English does. Many languages do not mark these differences, for example Finnish and Hungarian. This does not mean that these languages are somehow less perfect than English. It just means that they are different. Even English does not always make this gender

distinction in its pronouns, because 'they' can be used to refer to more than one woman, or more than man, or a group of men and women. Sutton-Spence, R. & Woll, B. (1999) p42. The Linguistics of British Sign Language.

Deaf children sometimes don't know who is being referred to by 'he' or 'she', and I have had deaf children tell me that HE and SHE are the names of people. I have had to explain to them that in English 'he' and 'she' refer to men or boys and women or girls respectively.

In Leeds, when I worked for the Deaf/Hearing Impaired Service, I carried out some research on one to one conversations between deaf children and deaf adults, and deaf children and hearing adults. These conversations were videoed for analysis. From this type of analysis, we could find out how much a child controls the conversation. We can see how much children change the subject and if the response is appropriate or inappropriate. In analysing the videos I used the discourse code developed by Conrad, R. (1979) The Deaf School Child.

	No of appropriate responses	no of inappropriate responses
Deaf adult	28	0 to 1
Deaf child	25	2 to 4
Hearing adult	23	1
Deaf child	13	12

This chart is an analysis of the conversation of one deaf child with Deaf adult and hearing adult. We can see that although the hearing adult has only one inappropriate response, the deaf child's inappropriate responses are greatly increased. This indicates that the child

is probably not understanding the hearing adult well as the Deaf adult. The hearing adult commented that when she asked the deaf child questions, s/he could see that the deaf child did not understand or misunderstood because her signing was heavily influenced by English. If the deaf child misunderstood the questions and the hearing adult repeated them, the deaf child would change the subject, whereas the Deaf adult took control of the conversation to ensure the deaf child understood the questions and subjects being talked about.

> A teacher of deaf admitted that about sign language in class: "We were very hazy about what we wanted to happen. We had been using Sign Supported English with nursery children for a short time, so our skills were bit shaky, to say the least. We needed help with our signing and with the children's. We needed to extend our vocabulary to give the children better access to the activities of the nursery. Our understanding of BSL as a language was rudimentary. I think we were still at the stage where we thought of it as a variation of English rather than a distinctly separate language in its own right. We tended to think of the deaf as a kind of walking dictionary and would say, "What's the sign for 'tadpole' or 'bread' or 'button' or whatever..." rather than "Can you talk to the children about the tadpoles? Or "Can you explain that we're going to feed the ducks and need some bread?" so we were frequently surprised when the reply was "In what way..." or "The deaf don't use that" or "Just fingerspell". We were puzzled if there was some uncertainly in the reply. Laye, C. (1988) Teamwork – A Teacher's Perspective in LASER.

> Another example is the singular and plural in BSL. Deaf children I worked with sometimes asked me why 's' came at the end of a word for a plural. I explained that in English words with 's' at the end were plural, and words without were

singular. But there was often still confusion over words like 'sheep', which does not change for the plural.

> The idea of countability is probably universal in the sense that it is readily accessible to all human beings and is expressed in the lexical structure of all languages. However, not all languages have a grammatical category of number, and those that do not necessarily view countability in the same terms. As explained above, English recognizes a distinction between one and more than one (singular and plural). This distinction has to be expressed morphologically, by adding a suffix to a noun or by changing its form in some other a way to indicate whether it refers to one or more than one: student/ students, fox/foxes, man/men, child/children. Some languages, such as Japanese, Chinese, and Vietnamese, prefer to express the same notion lexically or, more often, not at all. The form of a noun in these languages does not normally indicate whether it is singular or plural. For example, my book and my books are both wo-de-shu in Chinese (Tan, 1980).
> Baker, M. (2006) In Other Words p.87.

In BSL, there is no separate sign added onto a sign to make it into a plural. A fingerspelled 's' is only added if the word that is being pluralized has also been fully fingerspelled. Signs can be repeated to show plurality. The sign STUDENT is a single 'c' handshape moving downwards once, and STUDENTS is the same handshape moving downwards twice. CHILD is signed by moving a flat palm handshape briefly downwards, and this is repeated and moved right to left to create the sign CHILDREN. A number can be added and this can flow into the sign CHILDREN, so that THREE CHILDREN is all signed with the THREE handshape (this only works up to FIVE). FOX and MAN, however, for example, cannot be repeated in this way, so the sign that indicates 'many' of something (flickering fingers with hands moving apart) is used after the sign is given.

Facial expressions can be added to distinguish whether there are very many (puffed cheeks) or just some (pursed lips).

> Some plurals are made by repeating the sign, with each repetition distributed in different locations, e.g. CHILDREN. The sign CHILD is a free morpheme, but the extra movement to show the plural is bound to CHILD. VIDEO-CAMERAS, STUDENTS (or PERSONS), and HOUSES are other examples... The movement is usually repeated three times, but this does not mean that there is three of something. The same movement is seen whether there are three children or ten. Only signs that are not body-anchored can pluralise in this way. Sutton-Spence, R. & Woll, B. (1999) p106. Linguistics in British Sign Language.

> There is information about number in verbs, too. BSL verbs give information about whether an action is performed more than once, or if more than one person is involved in the action. In the verb I-TEACH-THEM-ALL, the sweeping movement of the verb TEACH indicates that a group receives the single action of a single person. In the verb I-TEACH-EACH-OF-THEM, the repeated and distributive movement indicates that a number of individuals each receives the single action of a single person... This contrasts with the absence of distributive movement in I-TEACH-HIM. It should be noted that repetition of movement in a verb can have different meanings depending on the rest of the sentence. Repetition of GO, for example, without distributed movement can mean either that one individual goes repeatedly, or that many individuals go. Sutton-Spence, R. & Woll, B. (1999) p108. Linguistics in British Sign Language.

In chapter 7 I will give some examples of translating assessment questions which illustrate some of the issues around how plurals are signed in BSL, such as tossing some coins,

signing 'tens', cars in motion, and repeating the sign GIVE in the phrase 'give some sweets to three friends'.

Some languages have special 'number words', just for the purpose of indicating number. BSL has specific signs for numbers used in different situations such as solving problems, understanding measurement and graphs, knowing how to use calculators and data processing software.

Pronouns: The number system in BSL is complicated. For example, BSL has pronouns for numbers of individuals: ONE, TWO, THREE, FOUR, FIVE. The handshape FIVE is also used in the sign HOW MANY (but with movement of the fingers). English is more limited than BSL in terms of number pronouns. In BSL, WE (you and me, we two) are signed with the TWO handshape but with obligatory dietic information. WE (we three) are signed with the THREE handshape. WE (the four of us) is signed with the FOUR handshape, and WE (the five of us) with the FIVE handshape. ALL OF US is signed with an open hand making a sweeping movement through the signing space.
There is also a phenomenon called 'pronoun copy.

> In pronoun copy, the index used for the pronoun is repeated at the end of the sentence. This is very common in BSL, for example;
>
> GIRL Index.. RICH Index.. ('The girl is rich')
> Index.. DEAF Index.. ('I am Deaf')
>
> In English we might say The girl's rich, she is, or I am Deaf, I am, but this is unusual in Standard English, and much less common than pronoun copy in BSL.

> Pronoun copy is often accompanied by a head nod, especially if the sentence is emphatic. It is also possible to leave out the manual sign altogether and just nod in the direction of the pronoun. Sutton-Spence, R. & Woll, B. (1999). Linguistics in British Sign Language p54.

In an interaction between a deaf child and a hearing teacher, captured on video during research, we can see misunderstandings taking place around the use of pronouns in BSL. The deaf child had been asked a question about 'who'. The child responded by pointing at the location of the person being talked about (the father) rather than using the sign FATHER. The teacher wanted the child to sign FATHER or DADDY, but instead of changing how she asked the question (for example, asking MUMMY DADDY WHICH?) she pulled the child's pointing hand down, got closer, holding the child's hands down, and asked again "who?" The child was unable to reply, as their hands were being held down. The teacher let go of the child's hands and asked CAN YOU TELL ME AGAIN WHO? This happened several times, with the teacher always asking the question in the same way. The child took control of the conversation at this point by changing the topic and talking about something the teacher didn't understand. Communication had broken down.

After the unsuccessful interaction was over and the video stopped I was able to explain to the teacher that asking the question in a different way would probably have elicited the answer s/he wanted. I explained her that it was wrong of her to hold the child's hands, that this was a cultural conflict and actually prevented the child from communicating, and synonymous with someone putting their hand over a speaking person's mouth to stop them from speaking. From this experience, the teacher learnt not to hold deaf children's hands down to prevent them from signing.

English is more limited: the plural 'you' and all with English can be expressed as 'all of you', 'one of you', 'them all', 'each of you', and 'yous'.

> BSL has many more pronouns than English. English has pronouns for one, and pronouns for more than one. For 'singular' (pronouns referring to one), we have I, he, she, it, and you. For 'plural' (pronouns referring to more than one) we have we, and they. They covers he, she and it, while you is the same whether it is singular or plural.
>
> BSL has pronouns for (individual) one, two, three, four and five (although there is some disagreement about five) and for (plural) many. This means that instead of being limited to we, as English is, BSL has WE-TWO, WE-THREE, and possibly WE-FOUR and WE-FIVE as well as WE-ALL and EACH-OF-US. The same applies to 'you' and 'they'. Sutton-Spence, R. & Woll, B. (1999) p43. Linguistics in British Sign Language.

YOU (singular) is signed with one finger pointing at the interlocutor, and THEY is signed with the finger making a sweeping movement, as if pointing at many people, to indicate number (plural). YOU (plural) are signed in the same way. Benice Woll and Rachel Sutton-Spence (The Linguistics of BSL: an Introduction, 1998) have described pronouns in BSL. The BSL/English Dictionary (1992) p100-101 calls this 'number incorporation' (number is incorporated into pronouns). The meanings are produced simultaneously, and number can be used adverbially or literally as in NEXT WEEK (the handshape SEVEN is moved forward from the cheek to indicate seven days in the future) or LAST WEEK (the same but with backwards movement).

In the Northeast dialect, the SEVEN handshape can be moved repeatedly against the cheek to indicate 'every week / weekly'. This can also be done in BSL with the TWO

handshape to show 'fortnightly', and the THREE handshape to show 'every three weeks'. In the Yorkshire dialect, the FIVE handshape moves along the palm of the other hand and changes to a ONE, TWO or THREE handshape to indicate 'next week', 'in two weeks', and 'in three weeks' respectively.

Deaf pupils will use their fingers to deal with numbers in many different ways - to count, add, take away, find totals, divide, work out a price, talk about measurements like 'feet' and 'sizes', to find percentages (handshapes 0 / 0 movement /), do measurements, do accounting, display results, and there are many more examples.

Talking about time also involves number handshapes. I have already mentioned the signs NEXT WEEK and LAST WEEK. Numbers of days in the past or future can be signed in a similar way, e.g. THREE DAYS AGO would use the THREE handshape and a backwards movement. Numbers are thus linked in BSL to time, the past and present, the date, the month, the year.

Time in BSL

BSL has four methods of showing time, and these have been called 'time-lines'. The first, time-line 'A', runs from slightly behind the shoulder on the side of the dominant hand to a space out in front of the signer. Time-line 'B' runs along the fore-arm of the non-dominant hand. Time-line 'C' runs from left to right (or right to left for a left-handed signer) in the space directly in front of the signer at about waist height. Time-line 'D' runs from about thigh height up the side of the signer to about head height.

> BSL seems to use the right side of the face as mid-point with the signs DAY, YESTERDAY, and TOMORROW involving initial contact on the right side of the chin. The cheek is the tab for the future marker WILL which involves a forward twisting action. A series of signs indicating past time reference are articulated

above the right shoulder. Several signs are frequently given the English gloss BEFORE, but these signs can probably best be separated out into a neutral PAST marker, and a series of more specific time adverbials such as A LONG TIME AGO, LONG AGO and RECENTLY. NEUTRAL PAST seems to occur regularly in pre-subject position but it can occur several times throughout a text, not only in initial position. A manual sign can itself be modified by a non-manual adverbial. Thus manual A LONG TIME AGO can be accompanied by a non-manual intensifier, with cheeks puffed out, emphasising the length of time. RECENTLY can be accompanied by a non-manual modifier to indicate 'just recently'. Marking time in BSL, Brennan (1983) in Language in Sign: An International Perspective on sign language eds. (1983) Kyle, J. & Woll, B. p12.

In some geographical areas, calendric units such as week, month, and year are integrated within the time-line. The most common forms are connected with day or week, in signs such as LAST WEEK, NEXT WEEK, EVERY WEEK, and WEEK AFTER WEEK. Within the time line they can still be modulated for aspect. Thus we can compare NEXT WEEK, LAST WEEK, EVERY WEEK, and WEEK AFTER WEEK at different time lines. Wherever they are placed the same underlying modulations can be expressed.

The form YEAR is also articulated in neutral space and forms such as FOREVER and EVER can be seen as derived form YEAR. It is also worth noting that as with other calendric units, numbers can be incorporated into the signs so that we have TWO YEARS AGO, IN THREE YEARS TIME, and that again aspectual modulations can be applied to express meanings such as YEARLY, and YEAR AFTER YEAR. Brennan, M. (1983:16).

> Age is normally expressed in BSL by using a front face tab, typically the nose: hence HOW OLD and FIVE YEARS OLD. We have noted an interesting tendency for signers to modify signs indicating WHEN I WAS THREE so that there is reference to what one might think of as ontological time, i.e. an individual's life time. Brennan, M. (1983:23).

There are many borrowings to do with number and counting. The signs CLOCK and TIME have borrowed English lip patterns, as do the signs ONE-O-CLOCK and TWO-O-CLOCK, and so on. Lip patterns are used regularly with number signs. YEAR and MONTH also have these lip patterns. It is easy to recognise many lip patterns that look like English words in BSL signs, however, they are inextricably linked to the handshapes and movements and other parts of a sign.

A problem with the National Curriculum National English Word List Approach:

The National Curriculum encourages teachers to make subject word lists. This is a problem for teachers who sign with Deaf children who are advanced learners in BSL. If teachers using sign language to teach Deaf children introduce English subject vocabulary as part of their teaching, the child might not be able to relate the concepts to different contexts. Perhaps the context will make sense to the child some of the time, and not make sense at other times. This relates to the discussion above about a hearing teacher's use of flashcards to teach concepts such as 'stop', 'light', 'back', 'big' and 'small'.

One of the National Curriculum English Word List words is 'pattern'. This creates a problem for users of BSL. There is not one fixed way of signing PATTERN for use in all contexts. For example:

"Which shape comes next in this pattern?"

Or:

"How many circles can you see in this pattern?"

(In this case, 'circles' would have to be fingerspelled so as not to give away the answer (the sign CIRCLE is a forefinger going round as in a circle, which would provide clues to deaf pupils).

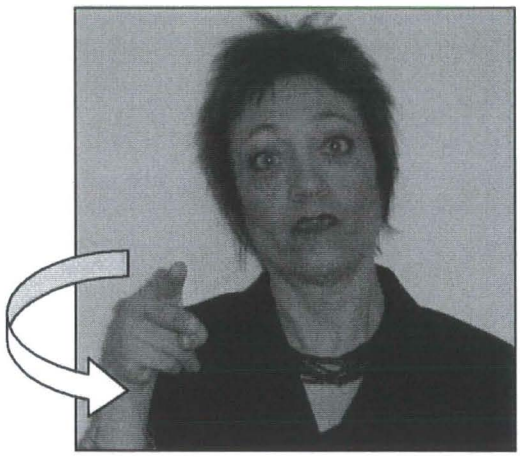
It is not necessary to understand the word 'pattern' to understand what the question means. These are called 'pop' questions. Once again, 'pattern' would have to be fingerspelled, which links the question to English words rather than creating understanding in BSL. Using a sign for 'pattern' wouldn't make sense, so this question becomes quite difficult to translate.

Sometimes it is difficult to give a list of words without contexts for those words. Signs given by them often do not make sense because they must be signed in context. This means words on the list have to be fingerspelled.

When do we use numeracy?

Mathematics is really a school subject. It is important part of everyday life. Without maths people would be 'ill', not only in school, but also in many everyday activities. Sharing valuables with friends, planning how to spend pocket money, arguing over minutes, distance, travel, different currencies, understanding the world's money, buying and selling, paying a mortgage, insurance policies...for all these things, maths skills are needed. Maths principles and skills learned in schools are to be respected and will be used often in school and home.

Signs have been developed by Deaf children in the 21st Century and have spread throughout the community. One example is the sign EURO, which is a signed version of



the written symbol €. This is now used all over the Deaf community. The sign was borrowed from Greece, where the Euro is used as currency, and has spread all over Europe. It will be interesting to see whether, as more countries adopt the Euro as currency, their respective Deaf communities develop their own signs for 'Euro', or whether they will continue to borrow the Greek sign EURO. From my own experience travelling in European countries and meeting Deaf people the latter appears to be happening.

Britain currently still uses pounds and pence, but people are now travelling more within Europe. The fact that EURO has been borrowed from another sign language into ours shows how sign languages influence each other and change over time. In the same way, signs for different types of money show how signs in BSL die out (signs for penny, tuppence, threepence, sixpence, shilling, and halfcrown have all died out). This happens in sign language all over the world – in Greece, the sign Drachma old Greek currency has now died out. The emergence of other new signs recently such as DVD and CD ROM also show how quickly BSL is changing.

The circulation of new and borrowed signs in the BSL community highlights again the importance of Deaf adults being involved in the education of deaf children. New and borrowed signs cannot reach children in schools if they do not have exposure the BSL used by the adult Deaf community.

All the examples given in this section demonstrate that when we have hearing second language users of BSL teaching (who are often not fluent) deaf first language BSL users in the classroom, we have a situation that is fraught by different kinds of communication issues and problems. Misunderstandings are an everyday occurrence in these classrooms, and make both the job of the teacher, and the experience of learning for the child very difficult. At a time when the child's language is developing rapidly and needs constant high quality input, they are being put in a situation where communication is a stressful and difficult ordeal.

Deaf adults working in education can work with teachers, using video of the teachers' signed interactions with pupils, to develop their BSL skills. Sadly, I have found that not all teachers are open to this type of support, and there is still a problem in deaf education in the UK with teachers believing that English is the priority for deaf children to learn. These issues can only be addressed by employing Deaf professionals to work alongside hearing teachers in classrooms, and by ensuring that teachers have a high level of sign language skills themselves (Level 3 or 4 minimum).

Personal experience leads me to be concerned that this change is not happening fast enough. Only several years ago, when I was employed as a support tutor in a college for the Deaf, I was told by the head of the college that I was not allowed to use or to talk about BSL. I was told that I was a Deaf leader and responsible for Deaf power. What did they mean? Telling me not to use BSL meant that Deaf people were being overpowered. I could not help being a Deaf leader. Deaf children and students like to 'talk' to Deaf adults. It is a thrill to them to communicate in their own first language. You cannot blame them and you should not stop them. Deaf people have a right to Deaf power, and Deaf people need Deaf power. Deaf people want to keep BSL as the language that brings them together and allows them to be strong.

Chapter 4

What is known about the performance of Deaf pupils using sign language in mathematics?

There is a dearth of research about sign language in relation to mathematics. Most of the research into sign language in education has focussed on literacy rather than numeracy. We now know quite a lot about how Deaf pupils acquire reading and writing abilities, but we know very little about the acquisition of skill in mathematics. The emphasis on literacy has not been not incidental. Teachers of the Deaf have long expressed concerns over the levels of English their Deaf pupils are achieving. English is seen as the priority, because literacy skills are thought to be of the utmost importance for Deaf learners. Consequently there has been very little discussion or research into the use of sign language in maths education for Deaf pupils.

During the 1980's, Wood, Wood and Howarth (1983, in Gregory, S. 1998) used the 'Vernon and Miller Rating Mathematics Test' to assess 414 Deaf school leavers, a large sample group for that time, and compared them with 465 comprehensive school pupils of the same age.

The average 'maths age' for hearing pupils was 15.5 years, while for deaf school leavers it was 12.3 years.

Maths age:

Hearing pupils	15.5 years
Deaf pupil	12.3 years

There were gender differences for hearing boys the age was 15.7 years, and for hearing girls 15.2 yrs.

Gender differences:

Hearing boys	15.7 years
Hearing girls	15.2 years statistically significant

For deaf boys the average maths age was 12.5 years, for deaf girls 12.1 years.

Deaf boys	12.5 years
Deaf girls	12.1 years not statistically significant, could be due to chance

This showed that there was a lesser difference between the genders in deaf school leavers, but also that there was a pronounced difference between the hearing group of both genders, and the deaf group of both genders.

They found that hearing school leavers achieved an average numeracy age of 15.5 years, while Deaf school leavers averaged 12.3 years. They also found differences according to gender. Hearing boys averaged 15.7 years, and hearing girls 15.2 years. In comparison, Deaf boys averaged 12.5 years, and Deaf girls 12.1 years. This shows that the difference between boys and girls who are Deaf is very slightly less than the difference between boys and girls who are hearing. However, the difference between the hearing group (both genders) and the Deaf group (both genders) is pronounced.

Hine (1970) "also found a considerable delay in mathematics age in a study of 104 deaf pupils. The delay for 10 year olds was about 2 years but the delay for 15 year olds was more serious: deaf 15 year olds on average showed a competence comparable to that hearing peers aged 10 to 11 years". (Nunes 2004) p4.

Research such as this displays a lack of knowledge about sign language, and Hine is trying to compare deaf pupils with hearing pupils, which is also misguided. This is not a fair comparison. Instead, why deaf pupils are having trouble acquiring language, and who is teaching them and by what methods, should be the topic of investigation. Hearing researchers such as Hine produce research results that create further barriers for students who are native users of BSL. Using terms like 'hearing loss', they also display a negative attitude towards deafness.

Wood and his colleagues' results appear to show that hearing school leavers have an average knowledge of mathematics equivalent to roughly 15 years, but that for Deaf school leavers average maths age is around 12 years. However, it is imperative that these ages be studied in comparison with the average school leaver's reading ages, which for Deaf pupils is low (9). Deaf pupils display a marked delay in both literacy and numeracy skills.

"...tested the attainments of over 100 deaf children aged between 7 and 16 using a standard test called the 'Schonell's Essential Mechanical Problems of Mathematics Test'. They found that partially hearing 10 year olds had an average attainment of 8 1/2 years. Those aged 15 achieved an average age of 10 1/2 in mechanical mathematics, but an average age of 11 for ordinary mathematics". (Hine:1970:133)

Hine noted that there was very little difference in the attainment of the deaf children tested between the ages of 9 and 11.

I would like to point out that both Wood and colleagues, and Hine, used testing methods that were reliant on English and reading, and they make no mention of BSL in their studies. The children were tested with written tests and no signing was used in the testing

process. It is vital that tests with Deaf children are performed using BSL if such tests are to have any validity. It is therefore quite possible that the Deaf children tested had an understanding of the concepts of mathematics, and a test carried out in BSL might have captured this, but tests that used English masked it. I do not accept that Deaf pupils' understanding of mathematics can be judged based on tests that use English. The tests used by these researchers might give us valuable results about something, but they do not give us reliable age levels for pupils' attainments in mathematics. If tests had been devised using sign language, the results might have been quite different, and Deaf children would not be judged as being so far delayed.

Tests used by hearing researchers almost always depend on the ability to read and write in English and also systems of signs. Those researching Deaf education seem to choose to ignore BSL, the first and natural language of Deaf people. Researchers who cannot sign themselves typically sideline BSL. My view is that it is wrong to use tests that rely on English to test Deaf children and to compare their attainment in these tests to that of hearing children. English is the first language for most hearing pupils in schools in Britain, but for deaf children this is not the case. English is usually the second language for deaf pupils, and researchers appear not to be aware of this fact, or to consider it when testing and comparing deaf and hearing pupils. People conducting the tests should be able to sign, and the tests that are used to test hearing children's levels of attainment should not be simply borrowed for use with deaf children. The tests should not be carried out in English, and sign language should not be excluded from them. For the tests, BSL users modelling natural language should be used. Also, when analysing results, whether the pupil has had contact with BSL role models, and how early or late this contact occurred, should be taken into account.

It seems that the research that has been carried out to date reflects very negatively on deaf pupils' abilities, and the fact that English is their second language is never mentioned as a factor in their results. Perhaps a fairer comparison would be to test deaf children alongside hearing children for whom English is a second language, rather than comparing deaf children with hearing, native English speakers.

The research mentioned shows differences to do with gender in hearing pupils - boys at age 15 are doing better in mathematics than girls of the same age. But Deaf pupils do not display this gender difference. At age 16, most hearing girls are averaging a mathematics age of 15, but both Deaf boys and Deaf girls are averaging an age of 12. Once again, one has to question whether the research was conducted in a fair way.

One has to ask the question: why are hearing boys doing better in mathematics than hearing girls? The answer seems to have something to do with problems posed by mathematics linked with the ability to think visually and spatially, and mechanically linked things. When tested on thinking linguistically, however, girls often achieve better results. The question can then be posed: are Deaf boys and girls more similar in their mathematical achievements because they have an ability to think visually and spatially? This will be important to examine.

Sue Gregory (1997) in Issues of Deaf Education said that Deaf children learn and understand in a different way to hearing children. Deaf children who were brought up using sign language are now developing their own ways of signing about numbers in schools. They develop these signs when working with Deaf classroom assistants or Deaf teachers of the Deaf. Thus, she claims the teaching of mathematics is improving compared to how it was taught in the past.

Gregory states that when discussing the teaching of mathematics to Deaf children it is essential that the use of sign language is part of the conversation, her research raised in her article. Maths education for Deaf children must be considered in the light of the history of language oppression consigned to Deaf learners by oralist education policies. The question must be asked: when Deaf pupils were banned from using sign language, how did they acquire numeracy? Did they find alternative strategies, for example counting on the fingers? These are questions examined as well by the researcher Nunes 2004 Teaching Mathematics to Deaf children. To expand on Gregory's questions: when oralism was used in schools, deaf children were not allowed to use their hands in communicate. In fact they were often forced to sit on their hands to prevent them from signing counting using fingers would not have been allowed.

> What is also important is that studies are now also showing that deaf children, given early enough access to signing input, are able to develop sign language grammar even where the signing input is relatively poor. Brennan, M. (1999). Challenging Linguistic Exclusion in Deaf Education. P3.

Why should mathematics be difficult?

Why is Deaf achievement in mathematics lower than that of hearing pupils? There may be a number of reasons for this.

Firstly, I propose that the specialist vocabulary required in mathematics poses a problem for Deaf learners. Words that have established meanings in everyday English are given different, specific meanings in subjects like maths and science, or are used in different ways. Barham and Bishop (1991:181) say that even at an early age, children should be introduced to new or potentially confusing words, for example "multiple" and rectangle", which often sound similar, especially to a child who uses lip-reading. They suggest that

word pairs like 'ten' and 'tenth', and 'sixty' and 'sixteen' are also difficult. As a native user of BSL I don't see these words as confusing, because there are clearly different signs for the different concepts they refer to, four / nine – same handshapes, three/eight – same handshapes but different lip-pattern. NINE is distinguishable from FOUR even though the sign is exactly the same because the lip pattern that is used with the sign differentiates them. These authors are ignoring the use of fingers and signs to convey numbers, and concentrating on the lip-reading of English words. Deaf people do use lip patterns to distinguish between signs as well (as in the clear difference in the lip pattern between TEN and TENTH), and 'sixty' and 'sixteen' appear the same on the lips but would also use the context in which the word was used to help delineate the exact meaning. If the topic was age, they would know 'ten' was meant, and if the topic was a list, 'tenth'. Children can also use context in this way, and therefore I disagree with their argument that these words are necessarily confusing for Deaf pupils.

Instead, I argue that the emphasis on lip-reading in the education system is part of the reason deaf children are failing in mathematics. Learning through BSL is largely ignored, and thus vital tools for learning about numbers (the fingers, and BSL signs) are pushed aside. For the same reason, tests that have been carried out on deaf pupils' attainment levels in mathematics show skewed results. (lip patterns) Educationalists persist in not talking about the use sign language and especially of fingers for counting. Hearing researchers have focussed on oral skills, because they have no knowledge of BSL themselves. The oralist education system works to disadvantage deaf children in the learning of maths because it the elements of BSL that are important for numeracy. Deaf children are denied the opportunity to use their fingers for counting and to learn signs for numbers in BSL.

There is a gap in understanding. Research does not show evidence of deaf children's understand of maths and numeracy through BSL. Deaf people involved in research into deaf of children's performance in mathematics are still oppressed as well. Researchers choose to ignore Deaf adults in the community who already use BSL signs in their everyday lives. Thus, results tend to portray Deaf learners as lacking in intellectual abilities, and deaf children have to bear the label of having, on average, poor attainment in mathematics, but these results are skewed.

> Deaf children have the right to equality of educational provision. Presumably few would argue with this simple claim. Government pronouncements would appear to support deaf pupils' rights. Current and recent government consultation and policy documents emphasise inclusion, pupil rights and pupil participation. Brennan, M. (1999) Challenging Linguistic Exclusion in Deaf Education.

I support Brennan's view regarding Deaf children have the right to equality of educational provision. Unfortunately, oppression of BSL has meant that deaf children's education has been far from equal. Teachers of the Deaf have traditionally placed deaf children in different classes based on their level of speaking skill. In addition, those pupils who were seen as being at a high intellectual level were put in oral classes, where the lack of sign language meant their education soon suffered. Pupils who were labelled as lower achievers were put in classes where signing was used, but the teachers were not very skilled signers, and their education suffered also. Classes where signing was used were considered 'lower' classes, and the teaching was less academic – focussed on sports, games, and so on. Levels of speaking skill should not be used as a measure of a deaf child's ability, rather, it is vital that all deaf children are given the opportunity to acquire sign language. This will give them the confidence to mix with both Deaf people and people with a 'hearing loss' when they are adults.

Repressing a deaf child's sign language development and identity as a Deaf person can lead to tragic consequences. One example of this was shown on television (See Hear, 2000). A deaf boy from Cornwall, aged eighteen, committed suicide. Before he hung himself, he had talked about being confused about his identity and where he fitted in the world. He was not confident about mixing in either the Deaf community or hearing society. A member of the Deaf community of Cornwall was interviewed on the programme, and expressed a wish that the Deaf adults of Cornwall had access to deaf young people who are isolated in mainstream schools. This tragic example illustrates the importance of making sure deaf children have access to sign language and Deaf culture. Lack of the use of sign language in education can also lead to other problems such as language delay.

> We know that deaf children have the same capacity for language as other children: hearing loss itself does not negate that capacity. Yet the typical experience of deaf children in this country is that their language will be delayed. This is an unnecessary delay. The willingness of professionals to argue for and to allow such needless delay must be more vigorously challenged. Brennan, M. (1999) Challenging Linguistic Exclusion in Deaf Education.

When we talk about 'language delay' we must be careful, however. Hearing professionals have often said of deaf pupils with whom they work that their language is delayed, meaning that the pupils are struggling with speech or English literacy. This attitude can provoke an angry response from Deaf adults, who can see that often deaf pupils in schools have missed out on sign language from a young age, and have had no access to Deaf professionals in their schooling. Likewise, Teachers of the Deaf may have neglected to learn sign language themselves, or have not used sign language with the deaf children

they teach. What should have been a wide and balanced education has been restricted for deaf children. Hearing professionals in education often say that deaf children do not acquire 'functional language competence' and that they lack ability in a number of tasks, including conversational skills. I have met some teachers who say that some deaf children have 'no language' – but these deaf children have a sign language of their own. These teachers cannot see that these deaf children do have language skills and can hold conversations. This was more of a problem in the past – the development of sign bilingual education has lead to some improvements, such as the requirement that Teachers of the Deaf learn sign language, and sign language is offered at in service training.

> The development of a sign bilingual approach to the education of deaf children has focused attention on the use of sign language in the teaching of different curriculum areas. Intuitively it would seem that sign language, being a visually-spatially-organised language, could have much to offer the teaching of mathematics. Because the language conveys more information about size, location and spatial relationships than spoken language, it could be a rich language for exploring and explaining mathematical concepts. Gregory, S. (1998: 124)

Gregory's comments support the view that sign language is essential in education for deaf children. However, at a conference of the British Association of Teacher of the Deaf in Oxford in 2005, teachers gave papers on their continued use of methods such as oralism and 'cued speech' in classrooms, proving that there is still a refusal to accept bilingual education amongst professionals.

> Cued speech - Hand cues are made near the mouth, to identify the different speech sounds which look the same on the lips (e.g./p/,/b/, and /m/) or those which cannot be seen on the lips at all (e.g./k/and /g/).
>
> This system does not use signs at all. It focuses on speech. Eight handshapes show groups of English consonants, and when these handshapes combine with different lip patterns, it is possible to identify each sound. The Forchhammer hand-mouth system in Denmark is a similar system. Ultimately, a person is not expected to rely on Cued Speech, but rather to use it as a tool to learn spoken English. Cued Speech is not BSL because it does not use BSL signs, and it always follows spoken English mouth patterns. The cues have no meaning on their own. Sutton, R. & /Woll, B. (1999) The Linguistics of British Sign Language. P13.

Very few Deaf people were taught using cued speech, and many in the Deaf community have never seen it used, and would not understand that cued speech hand shapes are related to sounds. Those who were taught by this method do not use cued speech once they leave school, and either learn to sign and join the Deaf community, or lipread and speak and move in the hearing world.

"The Bilingual-Bicultural movement suggests that all Deaf children should be given ASL skills first and then be taught English as a second language, while appreciating equally the Deaf and hearing worlds. This means that if sign language was taught first, we would see results in deaf children equal to that of hearing". (Emmorey, K. 2000) p329.

In addition, if a different approach was used when teaching deaf children, results might be different. For example, a maths task should be presented in written English (probably the deaf child's second language) in the first instance, then a BSL translation needs to be

shown, and then the English text looked at again, so that links can be made, and the concepts fully understood.

I will discuss the issue of translation into BSL of maths materials for deaf children in more depth, and will present examples of assessments that have been translated with the aim of not giving clues to the child about the answer. It can be quite easy to give away clues if English words are translated, and this must always be kept in mind when translating assessments. I will discuss this in more detail later in this paper, as well as commenting on how questions are read in English by hearing students.

BSL is a real language, in the same way that any spoken language (French, Italian, Welsh...) is a real language. This again raises the question of why BSL is not mentioned in any of the research about Deaf learners and mathematics.

"Deaf education is not about theories and experiments. It is about funding structures, pedagogical techniques, standardized test scores, traditions, and goals determined by the majority hearing culture". (Emmorey, K. 2000:330). The same problems occur again and again – funding structures, research trying to collect evidence, and so on.

It has been said that there is an 'interface' between natural language and the technical language specific to mathematics. This idea supports my hypothesis that, while BSL is a natural language, it can be used as a technical language, and mathematical concepts can be discussed using specific signs and examples.

To summarize, BSL is a real language in the same way as spoken languages such as Italian, French and Welsh are real languages. Again, the question has been raised as to why BSL is not mentioned anywhere in the research about D/deaf learners and

mathematics. Research by hearing researchers seems to remain behind a barrier, and does not consider pupils who are native users of BSL. The researchers themselves cannot sign, or, if they can, it is only to a very basic level, and this is typical throughout many years of research into deaf education.

If we are to accept BSL as a natural language on similar terms to English then we must accept that deaf children learn mathematic concepts through BSL. People conducting the tests should be able to sign, and the tests that are used to test hearing children's levels of attainment should not be simply borrowed for use with deaf children. The tests should not be carried out in English, and sign language should not be excluded from them. Even more importantly, the teaching of mathematics must be carried out in BSL, so that deaf children can acquire mathematical knowledge through their first and/or natural language. Then they can be assessed in the language which allowed them to develop cognitively.

Chapter 5

The Language of Mathematics – English and BSL

"The use of 'Deaf' rather than 'deaf' in this context is meant to emphasise the key fact that the babies were exposed to sign language, not that the babies were audiologically deaf.". (Emmorey, K P171: 2002).

"The first step in the improvement of Deaf education is the more complete understanding of the Deaf child's linguistic, cognitive, and social development." (Emmorey, K. & Harlan, H.: 2000:330).

This chapter will look at the language of mathematics in English and BSL and the cultural contexts. The two quotes above show that there is recognition amongst researchers that sign language must be considered when a child's language development and education are being examined.

Hence, in Durkin, K. & Shire, B. (1991:13) "Language in mathematics education brings together a great many issues. Language itself is the focus of diverse fields of study, all of which are relevant to mathematics." ".....consideration in syntax, semantics, pragmatics, discourse, literacy, sociolinguistics, language impairment, bilingualism/multiculturalism and others. Despite this variety, we do not pretend to have exhausted the full range of ways in which these two important areas of development intersect, and of course we would not deny that there are many other problems in learning mathematics beyond the linguistics."

"One gets an idea of the scope and complexity of language when comparing such phrases as 'shared by three', shared with three', 'shared into three' and 'shared into threes'. Mathematical understanding will depend on detailed attention to the meanings of such phrases (and later phrases like 'divided by three', 'divided into three' and divided into threes) as it is clear that a collection like a bag of twelve apples can be divided differently 'by three', 'into three' and 'into threes', (Anghileri, J. et al, 1997) p43.

Obviously, the point of view here is an English one. Other languages too are capable of a complexity and scope which can create confusion if not used appropriately and precisely especially in the context of education. The use of spoken English can create difficulties in learning place values.

"Significantly, the greatest irregularity is in the second decade, so that learning numbers in the natural counting sequence does not help understanding of place value at the critical point where it is first used!" (Wigley, A. 1997:114).

> Building on the ideas of Caleb Gattegno, Wigley indicates the way the English language is involved with the early learning of number and mathematical calculation. Learning about number and mathematics also involves leaning about standard written notation. He outlines a visual way of teaching place value by using a visual dictation chart and place value cards. He explicitly links this to learning about the sounds of English words: the regular and irregular ways they represent the base ten system. His other observations are also important for thinking about BSL and mathematics. Tate, Collins & Tymms (2003) P29.

BSL is really a visual-gestural language with its own conventions of regularity/irregularity for counting. There are regional varieties with conventions for counting and representing

the base ten system. Learning about the English language of maths involves being taught about the conventions of spoken and written number words, their relationship to the base-ten system and place value. Similarly, learning about the British Sign Language of maths needs to involve being taught about the conventions of number signs, their relationship to the base-ten system and place value.

"Children who can count, for example, up to 12, may nevertheless be unable to combine a 10p with two 1p coins to make 12p. In order to add the two 1p coins with the 10p coin the children need to realise that all the values up to 10 are contained or embedded in that single representation: an understanding of counting based simply on linear, one-to-one correspondence reasoning does not suffice." (Nunes, T. and Moreno, C. 1998:233).

The sign for POUND-STERLING is articulated using a 'one' handshape with the palm orientation towards the signer, touching then moving away from the chin (this is a location morpheme) It can incorporate the number of pounds being talked about by changing the handshape, as in ONE POUND, TWO POUNDS, FOUR POUNDS, FIFTY POUNDS, SEVENTY-FOUR POUNDS. This can be used up to NINETY-NINE POUNDS, and a separate sign for POUNDS is therefore not needed. With ONE HUNDRED POUNDS, however, each sign must be articulated separately, and the sign POUNDS must be used (there are three different versions of this – fingers wiggling at the chin, an index finger coming down to meet a flat palm, or a fingerspelled letter 'p').

The Deaf and Hearing Impaired Service in Leeds was asked for advice on the translations of Performance Indicators in Primary (PIPS) assessments for maths and science questions. There were a variety of number signs for the assessment questions. Deaf and hearing teachers who were experienced in using BSL to teach maths were consulted on the best ways to sign numbers for these translations, and one Deaf teacher was involved

in producing the signed translations that were filmed for the DVD. These teachers were concerned that appropriate signs for numbers were chosen to match the concepts being tested. We discussed the importance of considering the signs for numbers in relation to different uses, for example telephone numbers or identity numbers. For example:

"What is 60 hundreds added to 6 hundreds?"

The sign for 60 (SIXTY) should be used for this question. Discussion was held with the sign bilingual policy service over the issue of numbers, and it was agreed that the sign 60, articulated with the little finger tapping the thumb (see photo), was preferable rather than the signs 6 and 0 articulated as SIX then NAUGHT. This was because the phrase '60 hundreds' would look like SIX NAUGHT HUNDRED, and this would be confusing.

> There are regional variations for signing numbers in the teens. From 20 onwards, a new set of rules of combination applies: 20 is signed as 2 and 0, with a spatial displacement indicating the same organisation as in writing, 2 to the left of 0; numbers 21 to 99 follow the same rule. It should be remarked that the direction of signing (2 to the left of 0) is the opposite of the direction as perceived when the observer faces the signer. This is actually always the case in sign languages. This means that there is a spatial rotation when perceiving in comparison to signing numbers. Nunes, T. (2004:32) Teaching Mathematics to Deaf children.

It is not clear from the quote if Nunes wants to say that either the perception of BSL signs or the perception of written numbers is less confusing for a learner – it seems to imply there is a problem. From a Deaf cultural perspective this is not an issue - just as learning English counting system for hearing children compared to Taiwanese hearing children learning spoken Taiwan – even though it is 'easier' for hearing children in Taiwan.

Children learn the system and cultural logic. Nunes neglects to mention another 'complication', regarding left-handed and right-handed signers. I am a left-handed signer myself. Deaf people who sign with their left hand as the dominant hand would sign 20 with 2 to the right of 0. Hearing learners of BSL as a second or third language can sometimes get this wrong – right-handed learners might sign 20 with the 2 to the right of 0, and left-handed learners might sign it with 2 to the left of 0. These learners also often try to copy their tutor in a mirror image (thus signing the number in the wrong direction) or to make the sign 'read' from left to right for the person they are signing to (again, going in the wrong direction). These issues must be taken into consideration in any discussion of the use of numbers in BSL. Teachers need to be aware of them when they are teaching young Deaf children as they are aware when teaching young hearing children the spoken language system.

The Deaf community already have established signs for numbers over 10. There are signs 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, and 30, 40, 50, 60, 70, 80, 90, etc.

11

12

13

14

15	16	17	18
			
19	**20**	**30**	**40**
			
50	**60**	**70**	**80**
			
90			

The problem is that children need a clear concept of numbers. Signed numbers up to 19 follow a clear logic as their meaning incorporates TEN. One dialect of BSL follows a compound system where one of the morphemes is TEN. Other dialects incorporate TEN by having a movement morpheme as part of the sign (see photographs 11 to 19 above)

One commonly used sign in the Yorkshire region for 20 is signed TWO ZERO. Discussion among Deaf people has been held in that region about the usefulness of this sign in the teaching of children, and there is concern that it can confuse children, who may

think that the number is below ten, because 2 and 0 add up to 2. Similarly 30, 40, 50, and so on, could be signed in the same way. It would be better to use the single signs TWENTY (thumb and forefinger tap together twice), THIRTY (thumb and middle finger tap together twice), FORTY (thumb and ring finger tap together twice), and so on (which are also widely used in Yorkshire*), while children are* learning about numbers and acquiring BSL, so that they understand about numbers over ten. (see Chapter 6 for more about Tens)

When you count in BSL, you start with ONE, TWO, THREE, FOUR, FIVE (holding up the number of fingers on one hand which match the number). SIX has the little finger held up - which derives from starting to count with the next available finger after all the fingers on one hand are used in FIVE, so it has a logical connection to 'six' (five plus one). The signs SEVEN, EIGHT, and NINE follow this logic (one more finger is held up for each). TEN can be articulated with two full hands of fingers held up, or a sign TEN (the fist).

There are two variations of the sign ELEVEN - (Thumb and forefinger tapping twice, or thumb wiggling up and down twice). I believe that we have a different way of thinking in BSL. Deaf children, once exposed to a variety of regional signs, can easily accept and understand that there are different dialectical signs for numbers.

When we sign TWENTY-ONE what is meant is 'two tens plus one'. There are possibly six or seven regional variations of the sign TWENTY-ONE in BSL (it can be signed as with the sign TWO and then the sign ONE to the right of it, or as the thumb and the forefinger tapping together (in the North East sign for TWENTY) and then the thumb extending (an interesting variation, as ONE by itself is never signed with the thumb), or it can be signed with the TWO making a sweeping movement and the handshape changing to a ONE, to

give just three examples). Regardless of regional variation, the meaning is always the same.

We count hundreds in 'ten' and 'tens'. The phrase 'three hundred and forty-five" needs to be considered in detail, for example. If we use the sign HUNDRED (thumb moving across and down) the meaning is clear. If we use the alternative sign HUNDRED (ZERO-ZERO) then 345 can look like 30045 (because it is signed across the signing space in the same way, as a telephone number would be).

Brennan (BSL/English Dictionary,1992:823) states that Deaf people in Britain use a "range" of number signs, and that this is an area of special interest for BSL researchers. Nobody has yet worked out exactly how many different signs there are that express numbers. It appears that most signers of BSL understand each other's varieties when it comes to number signs well, and can communicate with each other with few problems. Most systems use a one handed system for number signs. There is one example of a two handed system for number signs used by people in Manchester, and they are the only group to use this.

Brennan states that in Britain use most systems one handed for number signs apart from by people in Manchester. There is also Irish Sign Language not included British Sign Language. "Numbers in ISL become two handed after number 5 and change back to single handed articulation for 20 – 25, 30 – 35, etc. Numbers 6 – 10 incorporate a '5' base hand that may be left out for the purposes of categorizing Handshapes. Numbers 9 and 10 however are the same handshape as 4 and 5. After number 8 therefore, a different method of listing is needed". P.Matthews (2005) p46.

In this system, the non-dominant hand holds a TEN (fist) hand-shape. ELEVEN is articulated by placing one finger (the forefinger) on top of the fist. TWELVE, THIRTEEN, FOURTEEN and so on are created in the same fashion, so the 'teens' show that they are based on ten, with a number added. This is very interesting.

The questions that need to be addressed are: How should sign language link to education? If we think about using signs for maths words, how are they used in the Deaf community? What ways are teachers linking in with cultural knowledge?

The nature of abstract words in both maths and science is an important issue. When people try to 'evolve' new signs they often try to make them relate to the concepts they represent. I was recently involved in translating a PIPs assessment onto video for use with Deaf children. The video was developed for use with deaf children both in mainstream schools and Deaf schools. The aim was that either hearing teachers of the Deaf could watch the video to gain insight into how to sign maths questions to their deaf pupils, or that deaf children doing maths assessments watch the video themselves. The assessment questions were signed in such a way that they used the grammar of BSL but not in such a way as to visually make the questions redundant. They were carefully constructed questions signed in BSL in the same way as written questions for hearing children are carefully worded.

Valuing the knowledge and achievements of pupils who prefer to use BSL:

Very little is known in official educational circles about the achievements and knowledge of students who prefer to use BSL. Researchers who use BSL themselves have witnessed that there are problems with assessment methods, because the methods themselves seem to cause change.

> "... there is a shift away from language issues ('modes' of communication) to the quality of education on offer [...] Nevertheless, language issues still plague mathematics assessments, although some attention is now being devoted to the often bilingual or even the multilingual nature of mathematics teaching and testing. "(Powers, S., et al., 1998:77-8).

This shift is having an effect on maths education not only in the UK but in other areas of the world as well.

There is still a dearth of research into the abilities and knowledge of pupils who use and express themselves in BSL. Conrad, R. (1979) his research was conducted with pupils who were educated in schools that adhered to the 'oral method' of education. However many of these pupils did actually use BSL, for example, at home as their home language.

> "All of the children have English as mother-tongue and this is taken to include those from homes where signing is the normal mode of communication. [...] Test instructions were normally given in speech. Signing and pantomime were freely used when necessary, and of particular value was the assistance given when one child clearly understood the spoken instructions and was able to translate for those who had not."(Conrad, R. 1979 pp 37-8).

Conrad says that all the children he tested had English as a mother tongue. He writes this at a time when BSL was only beginning to be recognised as a real language. It is now accepted that BSL is a language and as such can be a person's 'mother tongue', which is obviously the case for the children he tested who came from homes where signing was the normal mode of communication. At that time, there was also little knowledge about the

use of BSL in classrooms. Conrad tested the children's 'non verbal' intelligence. This only included language instructions / coaching at the outset. If BSL had been recognised as a language and if there had been more research on BSL available at the time of Conrad's study he could have gained a much more qualitative understanding of the Deaf children's knowledge.

In the 1990s a bilingual (BSL and English) educational approach was developed in Deaf education, and was introduced into some schools (See Pickersgill, M. 1998). Since then, the education sector has welcomed researchers from different perspectives, some of whom use sign language. Swedish researchers Molander, Pederson and Norell explain how this can be done in their introduction:

> The focus in research in science education has shifted from pupils' conceptions of individual topics in science subjects to questions concerning science, communication of science, and the learners' participation in scientific discourse. (Molander, B-O., Pederson, S. and Norell, K. 2001:201.

They use the results of their research to make a tentative comparison between hearing and Deaf pupils' use of scientific concepts, models and theories. Their questions were designed to test Deaf students' comprehension of scientific concepts. Their perspective is that the learning of science can become socialised into the culture of Deaf students, and an open and positive perspective developed about it, and that when students understand the concepts these will be incorporated into their use of Swedish Sign Language. This understanding can then be used in a social/educational context, and the knowledge linked to sign language. Their follow up work on improving the testing of pupils' understanding of science included suggesting interviews and discussions in sign language with pupils using an interpreter. They recognised that this in itself would create a new set of problems, as

the researchers themselves don't know sign language, and would have to rely on the interpretation. It would be better if they could use sign language themselves.

"Because of our insufficient knowledge of SSL, the interviews were conducted through interpreters, which adds to the risk for misunderstandings." (ibid)

Another problem they predicted with interviews is the lack of standard vocabulary in Swedish Sign Language for scientific concepts.

I would like to suggest the same kind of consideration be given to the use of signs related to mathematics and numbers. This is sometimes a question of being precise in what is perceived as a problem. It is probably more accurate to think of sign languages as having (as spoken languages also do) a variety of ways to discuss concepts rather than a 'lack' of vocabulary. I would suggest that all languages, including spoken languages, have a variety of ways of talking about different concepts. Hearing researchers who don't know signed languages would benefit from bringing in interpreters to work alongside them, rather than claiming the signed language is lacking in vocabulary.

Why do maths assessments need to be translated from English to BSL?

The first challenge is to ensure teachers are asking the same transformed questions and that therefore the responses are valid. A standard way of presenting questions in BSL for assessment needs to be created. This is easy in English because it has a written form and a standard grammar. Assessment questions in English are printed and either given to pupils to read or teachers to read out to them. This means everyone doing the test either reads or hears the same version. However, BSL does not have a commonly used written form, so those students that prefer to use it are often simply given the tests to read in English. Standard BSL assessments have not been developed for signing children.

If teachers were to translate the assessment questions into BSL, they would not all translate them in the same way. Some have better skills in BSL than others, but even so, all their translations would be likely to be different. Assessment questions would consequently be asked in a variety of ways.

> "One of the main issues in assessing child BSL is the lack of appropriate assessors. Even within bilingual programmes, there is often no individual with bilingual skills: hearing staff may have limited knowledge of BSL and deaf staff may have limited knowledge of English, and neither of these groups may have had any training either in the linguistics of BSL or in the acquisition of BSL. On occasion, professionals who do not know BSL or who have limited experience of deaf children undertake language assessments. Sometimes interpreters are used, which is always unsatisfactory. (Woll, B. 1998 p67).

Teachers are often not experts in translation, or even sign language experts. A minority (but it seems increasing number) of these teachers are themselves 1st language BSL users who also require the Instructions and Guidance in BSL. It should not be assumed that teacher's bilingual abilities (with BSL as either a first or second language) are adequate for translation of assessment materials. Children whose first language is BSL might still have trouble understanding a teacher for whom BSL is a second language, if that teacher is signing assessment questions to them.

Hearing children are provided with assessment questions in a standard form of their first language, English. They all have access to the questions worded in exactly the same way, so that the test is fair. Deaf children need to be offered an equivalent to this in their preferred language. It is not sufficient to suggest that their teachers can provide an

equivalent by reading the standard questions in English and signing them, live, to their pupils. Each teacher will undoubtedly interpret the questions in a different way.

A better solution would be to employ a Deaf translator to create standard translations of the assessment questions in BSL, and to use these for assessment of all Deaf children. The translations would have to be very precise, but once recorded on video, they would become a 'frozen' or standard way of presenting the questions and could be used throughout the country with Deaf pupils.

Another issue that must be taken into consideration, however, is variety in BSL. Just as there is variation in spoken language, so BSL has varieties to do with region and other factors. The fact that English can be written means that, while children in different areas might speak the variety of English of their area, they all have access to a standard form of the language. Therefore the spoken varieties become 'ironed out', and it is easy to make sure that assessments and other educational materials are standard across the nation. Deaf children learn BSL in their local areas and therefore use the vocabulary specific to their variety of BSL. The variety of different signs for number vocabulary can create problems when trying to develop a standard signed assessment system. There is no standard form of BSL. If one variety were to be used in the assessments, pupils from other regions would probably understand the signs used, but the fact remains that they would not be getting access to the assessments in their own variety.

One solution for this would be for teachers to show the pupils the videoed assessment questions, but to supplement them with the signs the pupils are familiar with.

Another approach to this would be for those teachers (Deaf and hearing) who have a high level of skill in BSL, to use a national standard video as a model for how to sign the

questions to the pupils. This would create standardisation, but allow for regional varieties of BSL to come through, and for questions to be presented in the most appropriate way for their school. Alternatively, the school may choose to use the national standard video, but require teachers to prepare their students for it by using signs from the video that are not commonly used otherwise in their school. Teachers may also decide to use the video as a model for their own signed versions of the questions presented to the pupils, in whom they would substitute the regional signs related to their area. We would advise, however, that the teachers that do this are highly skilled in BSL.

The questions aim to assess a child's understanding of language related to the mathematical concept of conservation. A translation of the questions must provide an equivalent so that the same knowledge and understanding is being assessed. That is, the signed questions should assess the child's level of understanding of these concepts in BSL, as well as their ability to carry out mathematical reasoning.

To come back to the first question: A teacher left to decide him/herself how to translate the question will use their knowledge of teaching the child mathematics as well as their knowledge and skills in BSL. However, teachers usually use spoken language with visual support, for example, systems like Sign Supported English (SSE) or other "sign systems". Teachers might also borrow signs or gestures that are visually motivated to denote size or volume. Teachers might usually use BSL with the child in the classroom but tend to use different strategies when faced with the task of translating a question. This can cause great confusion for the child who suddenly has to try to understand SSE or a signed system, supported by gesture and visually motivated signs, that they are not used to seeing. The meaning of the question in the written text can be obscured by the teacher's attempts to make it clearer.

Teachers who regularly used spoken English with a Deaf child also often use signs or gestures to support the spoken information. These are teaching methods aimed to aid a child's understanding of English. Research has shown that children sign to each other children sign to each other in ways that confirm to sign language structure and not English. (See Sam Supalla, 1990-91). Teachers have argued that using signs to support English benefits children in the early stages of maths development, and allows them access to assessments that come in a written English format. However, once again, this is a stubborn refusal to think about assessment in any way except in English.

If students are required to read the questions in written English, teachers may then back this up by asking the questions in BSL, SSE or other sign systems. Vocabulary may be taken from BSL to do this, which shows that there is still a need for a BSL model for assessment questions. Often, the teacher thinks signing the questions from the written English forms will help the child understand the concepts. They are likely, however, to sign the questions using an English word order, which can serve to cloud the meaning for the child. Once again, also, standardisation is lost. Some children may appear to understand the questions, but their answers will show that they were 'off track'.

Teachers may protest that they use gestures or borrow signs from BSL to support English because they don't want to make things too difficult for Deaf children. However, making things 'easy' is not the aim of assessment, and the methods used in classrooms by teachers are also separate issues to assessment. Assessments are developed to gather reliable data to check pupils' levels of attainment and they need to be standardised. The aim of the questions being written in English is to make sure they are presented in a standard way. Teachers using the above strategies are not presenting the questions in a standard way. It might aid the child's understanding of English, but will probably also give a false indication of the child's knowledge.

BSL vocabulary and grammar must be chosen that will assess the child's level of understanding of language as well as maths concepts. Some clarification of the term SSE is needed. SSE is an abbreviation for Sign Supported English, and this is what it actually is - English, with signs used as a support to English. SSE is not a language.

A person using SSE attempts to speak, and produce signs simultaneously in English word order. The grammar, then, is based on the English that is being produced orally. It is important to remember that SSE is not used for communicating with someone who is fluent in BSL, or even someone who is fluent in BSL and English. Therefore, it is a contact variety of communication (but has not been labelled a pidgin as such), English grammar is dominant, and thus there are few signed systems for numbers developed in classroom methods of communication. Spoken English is most often used, with extra visual support to back up the speech. Sign systems like these are artificial creations, and are not in everyday use in the Deaf community. Teachers who wish to manipulate assessments use SSE or other sign systems. Deaf children for whom English is a second language may be given the written assessment questions to read, and then receive an SSE version of the questions from their teacher, but may still not be able to understand the meaning of the question clearly. The teacher's presentation of the assessment questions can easily lead to a misunderstanding.

> In sign supported English (SSE), the key words of a sentence are signed, while the person speaks. This means the main vocabulary is produced from BSL, but much of the grammar is English on the mouth. [...] It is important to remember that SSE does not refer to a single way of communicating. Someone who is fluent in both English and BSL will use SSE differently form someone who is fluent in BSL

but knows only a little English, or someone who is fluent in English but knows only a little BSL. (Sutton-Spence & Woll (1998 p.16).

Sometimes a word in a question may be read by the teacher, and a sign used to represent that word, when in actual fact, if they were trying to give an English version, finger-spelling should be used. (This will be discussed further in chapter 7).

Questions signed in BSL can transform the meaning for a Deaf child of maths and science concepts. Children understand BSL better than sign systems like SSE, and these artificial systems often make meanings less clear for the Deaf child.

Here is an example from a PIPS question, baseline age 4-5: (year 2 Cd-Rom clip)

The English version reads:

"Here are three balls. If I took one away, how many would I have left?"

This could be signed in BSL like this.

IF THREE BALLS (NUMBER PRONOUN 3 HELD ON PASSIVE HAND) TAKE AWAY ONE (CHANGES TO NUMBER PRONOUN 2 ON PASSIVE HAND) ...

Children will immediately see the number two as part of the question! It is very easy in BSL to give away the answer.

A better translation would be to place the three balls in the signing space using proforms, then sign TAKE AWAY ONE, without location information ask the child how many are left.

The visual nature of BSL means that care is needed when signing assessment questions. Using fingers to reinforce that there are 3 balls, then taking away one of the 'fingers', which is one correct way of presenting this question in BSL, makes the answer obvious. The question must be signed without use of the pronoun forms for the numbers, if it is to match the purpose of the question in the source language.

The written question has a picture to show three balls, then asks how many would be left if one was taken away. Using number pronouns in this instance would give away the answer, because after one 'ball' was taken away, two fingers would be left. Therefore BSL model questions must be created in the same way that questions are carefully worded in English and adhered to regardless of whether the child is presented the question in written or spoken English.

Pictures of various shapes are provided, and the question asks:

"Which one is a star/circle/square/triangle/hexagon/?"

This question can be redundant in BSL, and needs to be adapted, because it is really asking if children know the English word for each shape (either written or finger-spelt).

Asking in BSL "which one is a star?" would work, because there is a sign STAR that is not based on the shape of a star. However, the signs CIRCLE, SQUARE, TRIANGLE, and HEXAGON are all visually motivated, that is, they are based on the actual outlines of the shapes. In signing these questions, one would be giving away the answers. To create an equivalent question in BSL one would have to show the child the written English word for each shape, or fingerspell them.

Cross cultural comparisons

Words only express shared meaning specific to language and cultural groups. The specific concepts that words express are often not shared cross-culturally.

> Shenkar and Von Glinow (1994) note that, when interviewing Chinese employees, a word such as "autonomy", which is a key concept in organizational research, "cannot be adequately translated into Chinese of that alternate Chinese terms, such as "right of self-determination". (zi zhu quan) convey a quite different meaning. (Hambleton, R.K & Patsula, L.1999 p67).

The word 'deaf' can be used as a pertinent example.

> The majority of people use the word 'deaf' (with a small 'd'). However, 'Deaf' with a capital 'D' refers to the minority of the population that most hearing people would view as having a disability - the lack of hearing. But 'Deaf', and the sign DEAF, are used by the Deaf community as a positive confirmation of a 'Deaf' identity, of belonging to a community that uses sign language (Brien, D. 1982 pp.350 and Collins, J. (1997).

The concept of sound is also understood differently by hearing and Deaf people. Hearing people have direct experience of sound. Therefore they have developed a sound-based, oral/aural language. Deaf people, instead, have developed a visually based, visual/gestural language. Deaf people still have conflict over sign language about sounds, that is, a way of talking in sign language about sounds.

For example, one science question (Assessment 6 Version A) asks: "Which moves fastest? A racing car? Sound? A rocket? Or light?" Talking about these concepts in BSL would require very careful consideration about how they should be signed. How, for example, can the concept of 'sound' be portrayed visually in BSL? These issues will be discussed in more depth in the chapter on translation of maths assessments for deaf children.

When translating English to BSL one has to compare cross-cultural data. If an English text is based on something to do with sound, it is very difficult to translate into BSL. An example of this is rhyme. Deaf people do not understand rhyme when it is based on words that sound the same (sign languages have their own ways of creating rhyme, using visual techniques such as repeated movements, but these are not based on the sounds of words or related to English in any way). Hearing people can hear the different sounds, but Deaf people relate to words visually, and thus when they read a text with rhyme in it, they won't see that the words rhyme. Deaf people have a different way of thinking, and a different way of perceiving sound.

When translating into a visual language some questions can also become redundant, and so the signs chosen must be carefully considered to avoid this. For example:

Question: Which one is a circle?

The BSL sign CIRCLE cannot be used, as it draws the shape of a circle. 'Circle' would have to be finger-spelled, as in:

Translation: -c-i-r-c-l-e- WHICH?

When creating signed assessments in BSL one has to think carefully about the meaning of questions and its purpose before deciding how they should be signed. The source language for these assessments is English and the English name of shapes is an important part of the mathematics curriculum and these names have to be used. As a visual-gestural language, BSL denotes the outline of shapes by visual means. It is clear when signing a question makes the question redundant. Fingerspelling plays an important part in some areas of BSL - especially naming. When signing assessment questions it is sometime important to use fingerspelling. The purpose of the question is used to guide decisions about when to include fingerspelling.

An important aim of the mathematics curriculum is for pupils to learn about the special characteristics of geometrical shapes. Shapes have names, and pupils must learn the different words for each shape. An example is the English word 'parallelogram'. Signs in BSL can be created for English nouns like this. A typical sign for parallelogram would include information about the shape having two sides that lean in the same direction. Thus, finger-spelling would have to be used for this concept in a question. The fingerspelling of names like 'parallelogram' is essential, so that children learn the English word associated with each shape, and are prepared to deal with them in assessment questions.

Therefore, finger-spelling must be used in a question like:

Question: "Which shape is a parallelogram?"
Translation: -p-a-r-a-l-l-e-l-o-g-r-a-m- WHICH?

The English nouns for shapes must be fully fingerspelled, and references made to the written words.

Fingerspelling each individual letter in a word like 'parallelogram' is not the way BSL users would usually deal with such a concept. But it is important for assessments so that children come to understand the words and their meanings. In the same way as hearing children recognise the sounds in a word and know which word is being spoken, Deaf children can learn to quickly recognise a word from its finger-spelled form.

The same thing happens when a lexical item becomes an established part of the frozen lexicon in BSL, for example, a sign name like DURHAM, which refers to the city or county of Durham. BIRMINGHAM is another example. There are signs for these place names, but they must also be fingerspelled so that children can make the connection between the signs and the written English words 'Birmingham' and 'Durham'. This needs to be part of the national curriculum.

> A parallelogram is a shape with two sides, which would never meet ('a quadrilateral whose opposite sides are parallel and consequently equal in length'). The question is eliciting the geometric name of a shape with two parallel sides. The pupils are offered drawings which are sufficiently different to be able to guess that the three distracters are not what is being asked for – if the pupil knows what a parallelogram looks like – approximately. This shape does not have a standard BSL name – although it would be very easy to create one. As BSL is a visual-gestural language any lexical item naming this shape would be motivated by its visual characteristics. However, to do this in a question would be like describing the visual shape and then asking the pupil to pick it out from the others. Collins, Tate & Tymms, Deaf Worlds Vol 19 (2003) p.13.

With hypothetical questions involving 'triangle' and 'equilateral', the same procedure should be followed.

'Triangle' is another noun that needs to be fingerspelled for the same reasons - the sign TRIANGLE is visual - it conveys the visual properties of a triangle. The child should be able to read the fingerspelling and make the connection to the written word. 'Equilateral' would also have to be fingerspelled.

"Put a tick on the equilateral triangle" (picture)

Decisions have to be made as to when the fingerspelling of English vocabulary items should be used. It is important for bilingual Deaf and hearing teachers experience of teaching the concepts to pupils is also important to consider. The steps to go through are:

1) the aim of the question. Is it trying to test pupils' knowledge of names or special concepts or test some other knowledge?

2) If yes, is there a commonly used equivalent in BSL? Will it make the question redundant because of the visual nature of BSL? (For example: "Which one is the triangle?")

3) If not, use fingerspelling and link it to the written English word.

An important point is the difference between concepts of real world events and words.

Number tells us how many individuals are involved. The English number system only has singular and plural, so we only know if there is only one person involved or more than one. The BSL number system is more complex. Woll, B. & Sutton-Spence, R. (1999).

Spoken language becomes highly regular for numbers. The sound of numbers would match the written form in being entirely regular. Children will have to remember and reproduce number words in the right order.

> ...the spoken English language is not, and here lies the root of a difficulty, if instead of '..... eight, nine, ten, eleven, twelve, thirteen,... nineteen', the conventions in spoken English were '.. eight, nine, one-ty (ie: one ten), one-ty one, one-ty two, one-ty three ..., one-ty nine, and if the decades followed 'one-ty, two-ty, three-ty, four-ty, five-ty, six-ty..., then the sound of numbers would match the written form in being entirely regular. Wigley, A. (1997).

If a regularised system such as the one suggested above were used with deaf children, even more confusion may be created. Lip patterns are an important feature of BSL signs, and lip patterns that are similar can easily be mixed up. For example, the lip patterns for THIRTEEN and THIRTY, FOURTEEN and FORTY, SIXTEEN and SIXTY, and so on are very difficult to distinguish. When deaf children are being taught with methods based on sound, they have to rely on lip patterns.

Sometimes, a lip pattern is used to distinguish between two signs that otherwise would look the same. FOUR and NINE have the same handshape and movements, but the lip pattern denotes their respective meanings. THREE and EIGHT, in some varieties of BSL, can also work like this, although in other varieties they have two different handshapes. This use of lip patterns to distinguish between two signs that would otherwise look the

same is quite a common occurrence in BSL. If number signs are used without the lip patterns it is harder for a signer to understand them, and groups of signs can be hard to distinguish, for example THIRTEEN / THIRTY, FOURTEEN / FORTY, FIFTEEN / FIFTY, SIX / SIXTEEN / SIXTY, SEVEN / SEVENTEEN / SEVENTY, EIGHT / EIGHTEEN / EIGHTY, NINETEEN / NINETY.

Another example is that BSL has many more pronouns than English. BSL has pronouns for (individual) one, two, three, four and five (although there is some disagreement about five) and for (plural) many. This means that instead of being limited to we, as English is, BSL has WE-TWO, WE THREE, and possibly WE-FOUR and WE-FIVE as well as WE-ALL and EACH-OF-US. The same applies to 'you' and 'they'. (Woll, B. & Sutton-Spence, R. 1999).

Children certainly have to remember all the English words for numbers from 0 – 10 since these are the basic words for the units. They have to learn and understand the number words for units of size and measurement, and for counting to a million. But, they also must have contact with people who use their mother tongue, such as Deaf families or Deaf professionals.

> What happens when a counting system has no base, structure, as the Oksapmin system? Their number words are the names of parts of the body taken in a particular order. The word for one is also the word for right thumb, the word for two is right index finger, three is right middle-finger, and so the numbers continue around the right hand, up the right arm, around the face on the left and then down the left side of the face and on until they reach the last finger of the left hand. (Nunes & Bryant 1996).

"...the Oksapmin of Papua New Guinea used until recently only a numeration system which was not a base system, they used the names of body parts to signify numbers." Nunes & Bryant,1996:45.

Whether this was a system used with a spoken language is not made clear. BSL can use the fingers on both the right and left hand for counting. Size and shape, length, width, and height are all signed using space and location.

Summary

Language is complex. Even focussing on this one domain of mathematics involves in-depth cultural knowledge of the language(s). Native understanding is vital for a teacher using the language with young children. Teachers and researchers of young children who learn through sign language need to be culturally competent. This discussion is inherently linked to the methods used by the Deaf signers involved in the project of translating the assessment questions. Research by hearing researchers seems to display a lack of knowledge of sign language and could not be relied upon to cover all the issues. I have discussed some of the difficulties, such as not giving away clues to the pupils by how the questions were signed, and also the issue of finding an equivalent to the way hearing pupils are asked the questions by reading or listening to them in English. It is essential that deaf pupils understand the meanings of the questions so they can answer them – if they are able – but also that the assessment questions give valid information. This was a difficult task to think about, and the translations took a long time. Mistakes could result in pupils being given clues and assessment questions therefore being redundant. The success or otherwise of teaching being wrongly assessed reinforce misunderstandings about sign language.

Chapter 6

Ten, ten, and tens

> In English we use base - ten system of counting. The number labels are reorganised when we reach ten, ten and so on. Up to nine, we count only units. From the number ten on, we count tens and units. This is not so apparent in the number words from eleven to nineteen but becomes more apparent in the number words from twenty on. When we say 'twenty one,' this word indicates two tens and one unit. From the number one hundred (that is, ten, tens) on, we count hundred, tens, and units. The phrase 'three hundred and forty five' indicates three hundred, four tens, and five ones. Our system thus helps us maintain the order fixed through the understanding of these conventions of regrouping counting units on a base – ten fashion. (Nunes & Bryant, 1996) p11.

Of course this system is not the only possible one. Other counting systems use different numbers of units for regrouping (base, twenty, for example).

In BSL one handshape for TEN is a whole fist. This is known as the handshape 'A'. However, the handshape for TEN varies depending on region. In the South it is a fist with the thumb up and the forefinger hooked over the thumb. The numbers one to five are signed as if counting with the fingers: the handshape for ONE is a fist with the forefinger held up; TWO is the forefinger and the middle finger held up; THREE can be either the forefinger, the middle finger and the thumb, or the forefinger, the middle finger and the ring finger; FOUR is the all the fingers except the thumb, and FIVE is all the fingers. SIX is a fist with the little finger help up; SEVEN is the little finger and the ring finger. EIGHT can be either the little, ring and middle finger (in Northern regions) or the middle finger,

forefinger, and thumb (in Southern regions). NINE is the four fingers held up, which is exactly the same as the sign FOUR. NINE is distinguishable from FOUR in several ways – a lip-pattern can be used, or the other hand can be held up with all five fingers so that nine fingers are showing. These are the two methods generally used by Deaf people themselves, however hearing teachers of deaf children have created another method to help them distinguish four and nine, and this has had some influence on native signers. This way is to sign FOUR with the hand held vertically, and NINE with the arm held horizontally, or the wrist bent so the hand is horizontal.

Numbers are signed differently all around the world, and this can cause confusion when signers from different countries meet. For example, in South African Sign Language, THREE and EIGHT use the BSL handshapes for EIGHT and THREE respectively.

In Kenyan Sign Language, FIVE is a fist handshape and TEN is created by two FIVE handshapes being brought together so the knuckles meet. The Kenyan sign THREE is the same as EIGHT in BSL. Like the Manchester dialect of BSL (see chapter 5), Kenyan sign language employs two hands to create some numbers. SEVEN, for example, is made by the FIVE handshape (the fist) being tapped with a TWO handshape. ELEVEN is signed by making the sign TEN, then one and springing away and turning into the ONE handshape. SIXTEEN is signed by giving the sign SIX (the ONE handshape tapping the FIVE handshape, but with just one tap) then the hands move into the sign TEN. Interestingly, Kenyan Sign Language uses exactly the same signs as BSL for the mathematical symbols 'plus', 'divide', 'multiply', and 'subtract'. Akach, P.A.O. (2001) Kenyan Sign Language Dictionary, Kenyan National Association of the Deaf.

In 1991 some filming of Deaf people signing took place at a Christmas party. One deaf girl, a pupil at a mainstream school and from a hearing family, was recorded signing the

number 16 while having a conversation with a Deaf adult about her house number. She made the sign ONE on her left hand and then made the sign SIX on her right hand and held them next to each other, as if portraying the way the number 16 is written in English. Possibly she was taught to sign numbers in this way at her school, and even though this was not BSL, she had found a way to think about and talk about numbers. The Deaf adults present had not seen this way of signing numbers before, but another girl (from a Deaf family and a pupil at a Deaf school) was able to understand and translate for them. (1991, Deaf Studies Research Unit, Language Acquisition Video Data).

I believe that Deaf people 'see' these handshapes in their minds as they count, rather than 'hearing' sounds of words for numbers or 'seeing' English words, but an extensive search of the literature has turned up no examples of research into this. This highlights a common problem in Deaf education related research and it's typical focus on its subjects' ability to hear English. Hearing researchers usually look at how deaf children acquire English and literacy skills. As a person who is Deaf and grew up with BSL as my first language, I have thought about this, but perhaps hearing researchers have never had cause to consider this question. Spoken English is based on sound, and numbers would match the written form in being entirely regular.

> Interestingly, the spoken language becomes highly regular for large numbers and here in perhaps lies the solution to the problem: introduce pupils as soon as possible to the whole structure, say of whole numbers up to 999, possibly beyond. Gattengo introduced a visual dictation chart for this purpose. The completed first three rows look like this:
>
> 1 2 3 4 5 6 7 8 9
>
> 10 20 30 40 50 60 70 80 90
>
> 100 200 300 400 500 600 700 800 900

> By building up the 'tens table' in the stages suggested below, working for fluency at each stage before moving to the next, the overall regularity becomes apparent and anomalies in the spoken language can be made a matter for explicit discussion. Wigley, A. 1997:115.

This table shows a system based on sound and spoken words but this would not be entirely relevant for teaching deaf children. More research is needed into how deaf people read using the visual mind when dealing with numbers.

"Understanding the neural systems involved in signed language processing can help… …. because sign languages are not based on auditory processing, are distinct from pantomime (symbolic gesture), involve complex motoric activity, and are clearly linguistic systems." (Emmorey, K. p. 273, 2001)

'Ten' English regional variety

'Ten' English regional variety

'Ten' Scottish variation 1

'Ten' Scottish variation 2

'Ten'

A – South West

Y – Scottish

5 & 5- both these handshapes are used sometimes with deaf pupils because they are clearly visual. They are not, however, used commonly in the Deaf community all over the UK.

There have been many discussions with the Sign Bilingual Consortium, which includes Deaf instructors and teachers who teach maths to Deaf pupils in mainstream classrooms from different schools such as Leeds, Birmingham and Derby, and of which I was a part. Deaf instructors who work with children in maths classrooms have advised teachers to use the signs TWENTY, THIRTY, FORTY, FIFTY, SIXTY, SEVENTY, EIGHTY, and NINETY (which use the thumb and a different finger tapping together twice and are used in the Yorkshire variation of BSL) rather than the signs TWENTY (TWO-ZERO), THIRTY (THREE-ZERO), and so on. The Deaf community uses the latter signs, but they already

have the knowledge that these signs indicate numbers over ten. Children might think of twenty, for example, as 'two and naught', and not come to understand the concept of 'twenty', if they use these signs. Children in educational settings need a clear way of learning and thinking about numbers, so it would be advisable to use the former set of number signs. The signs TWENTY, THIRTY, FORTY, FIFTY, SIXTY, SEVENTY, EIGHTY, and NINETY also make use of a lip pattern. These lip patterns are based on the English words. Sometimes this mouthing is less pronounced. This happens when a signer counts inside the mouth, as if talking to themselves.

Interestingly, Nunes and Bryant say that in one study, "the Taiwanese children could count in tens much better than the English children, and this no doubt was because the Chinese decade words are much more helpful than the English ones." Nunes & Bryant (1996) Children Doing Mathematics. P63.

An important point. I presume that in this instance, Nunes and Bryant are talking about hearing children. They neglect to mention the different ways that deaf children have of conceptualising numbers. Taiwan Sign Language is also different to BSL (and Taiwanese spoken language) and will have a different vocabulary set for numbers. Any language has its own number vocabulary that needs to be learned as part of the language.

We count hundreds in 'tens' and 'tens.' The phrase 'three hundred and forty-five' needs to be considered in detail, for example. If we use the sign HUNDRED (thumb moving across and down) the meaning is clear. If we use the alternative sign HUNDRED (ZERO-ZERO) then 345 can look like 30045 (because it is signed across the signing space in the same way, as a telephone number would be.

> Children certainly have to remember all the numbers from 0 to 10 since these are the basic words for the units, and they must also commit to memory all the teen words because some of these (eleven, twelve, thirteen, fifteen) are hard to derive from the system. They will have to remember the decade words because again some of them (twenty, thirty, fifty) are hard to derive from the structure. They will have to learn the words for units of a new size (hundred, thousand, million) – but that is all. With these 35 or so number words and a knowledge of how the system works the children could, If they had the time and the patience, count to a million and beyond. Nunes, T. & Bryant, P. (1996) Children Doing Mathematics. P15.

Another important point that teachers will be aware of. However, I believe that Nunes and Bryant miss another equally important point here when they say that with these few words, if given the time and patience, children could count to a million. Time and patience are not the only things deaf children need to be able to count to a million – they need signs. They need the signs that belong to the language and while make sense in the language. In this case the language is BSL. And it is hearing teachers who have lacked the time and patience to learn BSL so that they can teach numeracy to deaf pupils effectively. I would also stress here that Nunes and Bryant neglect to look at how deaf children and Deaf adults use mouthing when dealing with numbers. There is no research yet into this phenomenon.

Deaf people have their own way of using mouthing with numbers. Sometimes the lip pattern that goes with the sign ONE looks like 'one-th'. An extra pattern is added to the 'one' - a 'th'. When hearing people learn sign, some hearing people are able to pick up these details and use them in their own signing. This can confuse Deaf people, who may think that the hearing signer is Deaf themselves. However, it just means that they have mixed in the Deaf community and picked up this idiosyncrasy. However, the formal lip

pattern that goes with the sign ONE is 'one'. 'One-th' is just a lip pattern particular to some Deaf people.

> A distinctive feature is that the oral numeration system uses distinct expressions to indicate units, tens, hundreds etc. (five, fifty, five hundred) whereas the written system uses position from right to left (the value of the digit 5 in 50 and 500 is different although the digit itself is the same. Nunes & Bryant (1996).

Tens, hundreds, thousands and so on in BSL can be signed, as mentioned above, using the number and then a series of zeros (i.e. FIVE HUNDRED can be signed FIVE-NAUGHT-NAUGHT). For right-handed signers, these signs work like English words, and are signed from left to right. But for left handed signers, they are signed from right to left, and this does not change the meaning of the sign. In this way, BSL has it's own systems that are separate from written English.

Adult members of the Deaf community know how to talk about numbers clearly in BSL. For example, the number 82003 should be signed from the signer's left, moving to their right, and each number would be in a separate space as the hands move along. Telephone numbers are signed like this. This is much clearer than signing each number in the very same signing space - this is hard to read and looks as if the numbers are on top of each other.

This is clear in the same way as reading a line of figures from left to right is clear. However, it should be noted that right-handed signers sign from their left to their right, so for their interlocutor, the person reading the number, it appears to go from right to left. This is correct in BSL. Hearing people have tried to say that this is 'wrong', and BSL numbers should be signed from the signer's right, so that they appear 'the right way round'

for the person watching. The Deaf community doesn't accept this argument – they sign and read signing naturally, and to sign in a direction that looked 'correct' for their interlocutor would seem unnatural and odd. Left handed signers would sign a number from their right to their left, so their number would appear 'the right way round' to the interlocutor, but they only do this because they are left handed and it makes logical sense for them to sign it in that direction.

This is an interesting area - the use of dominant and non-dominant, as well as left and right hands, when signing numbers. Native signers are able to 'decode' the numbers with no difficulty, whether signed by a right handed or left handed signer.

The range of number signs used by different people in Britain provides particularly interesting example of variation in BSL. Nobody has yet worked out exactly how many ways are used by various groups of signers to express numbers. It would seem, however, that most British signers know each other's number signs well enough to communicate with each other. Most of the systems use lots of one-handed signs. A notable exception is the two-handed number system used by people from the Manchester region (BSL/Eng Dictionary, Brennan, M. (1992) p823). There is an alternative to the fist handshape for TEN in BSL, and this is simply both hands held up, palms facing the signer, with all the fingers extended and splayed. Other sign languages use two hands for numbers, for example Irish Sign Language, Kenyan Sign Language and South African Sign Language. In Irish Sign Language TEN is signed with two flat open hands with the fingers extended and splayed, one palm faces the signer and the other faces away, and the thumb of one hand touches the little finger of the other. The Kenyan Sign Language TEN has two fists meeting with the knuckles touching. The South African TEN brings both flat palms together in a clap ten the hands separate and the palms face outwards from the signer's body.

Brennan is correct that there is a considerable range of number signs used in Britain, and that most Deaf people understand them without difficulty. The problem lies, however, in mainstream schools. When deaf children are being taught by hearing teachers, with no Deaf adults present as either teachers of the deaf or classroom assistants, how is it possible for deaf children to understand and work with numbers?

For example, Nunes (2004) has collected some samples of children's signing in maths situations. One example (in diagrammatic form) from her work is of a child using the sign ONE-NAUGHT for the concept 'ten'. She accepts this as a BSL sign – "There are different ways of signing number 10 ... by signing 1 and then 0 to the left of the 1" (p.30) This is not a sign that would ever be used by native signers in the Deaf community. ONE and then NAUGHT to it's left would be used if talking, for example, about a football score of 1-0, but this is not the number 10. The only example I can think of where such a combination may be used is in the signing of the date '2010', however this is not commonly used yet. It will be interesting to see if this way of signing this particular number becomes widespread as the date approaches. EG: in Nunes 2004:31. Teaching Mathematics to Deaf children.

I predict that by the year 2010, two different signs for the date will be in common use by Deaf people. TWO THOUSAND TEN (with the THOUSAND signed as a couple of zeros run together, rather than the sign THOUSAND with the 'A' handshape making a downward movement on a diagonal) will be one sign, and the lip pattern for this sign is 'two-thousand-ten'. TWO NAUGHT ONE NAUGHT will also be acceptable. The lip pattern used for this combination of number signs is, interestingly, not 'twenty-ten' as is said in English, rather, it is mouthed as 'two-O-one-O'. This way of signing 2010 is a new sign that has developed only for the year, and is not used when talking about other numbers.

In Scottish sign variation the handshape for TEN has changed over time. Older Deaf people use a FIVE handshape with the forefinger bent at right angles, and younger Deaf people use the same handshape but with the middle finger bent. Both variations are still acceptable in the Deaf community. The aforementioned older signers' version of TEN could cause some cross-cultural misunderstanding between Deaf and hearing people, because the middle finger held out or up can be seen as an insult by hearing people. However this handshape is perfectly acceptable in Deaf culture. Interestingly, this variation of the sign TEN is not included in the BSL/English Dictionary (1999:838).

> To understand a measurement system fully, we need to understand the equivalences within the system. If we have on 50p coin we can buy as much as our friend who has two 20p and one 10p coins. If something is 1 metre and 20 centimetres long, it could be covered by three pieces of tape, two 50 centimetres plus one 20 centimetres long. Size of units is important both in counting and in ordering amounts. For example, if Kathy has ten 1p coins and Lisa has ten 10p coins, although they have the same number of coins, they have different amounts of money. Another example of the same principle is that if we measure a certain amount of sugar with tablespoons and then measure it with teaspoons, we get different numbers of spoonfuls; the larger the spoon, the smaller the number of spoons. Children Doing Mathematics, Nunes and Bryant (1996) p.49.

BSL uses compound signs to talk about some units of measurement. The three main units that can be signed about in this way are time, money and age. For each of these, a number can be signed beginning at a certain point on the face or body, and this will indicate that the number relates to that unit. For age, this point is the nose. Thus, the

handshape for TEN signed touching the nose and then moving slightly away from it means 'ten years old'.

> BSL bound morphemes cannot stand alone. While they do have meaning they are not independent signs. One bound morpheme may be the location or movement, while the handshape may be another bound morpheme. For example, in the signs: THREE-£ (pounds), THREE-YEARS-OLD, I-ASK-YOU, YOU-ASK-ME, DRIVE-CASUALLY, each is a single sign, but there are bound morphemes in each one. In THREE-£ and THREE-YEARS-OLD the handshape is a morpheme meaning 'three'. But the morphemes meaning £ or YEARS-OLD cannot be signed separately, because these morphemes can only occur in combination with the location and movement of the handshape. 'Hand at the chin' or 'hand at the nose' means £ or YEARS-OLD in some abstract way, but we cannot sign them without using a handshape to say how many pounds or years-old there are. Sutton-Spence and Woll, (1999), pp. 103-104.

The bound morpheme for age is only used when talking about people and animals, however, so that if a signer was talking about the age of a church or a car, they must sign each sign separately as in TEN YEARS OLD. It is also only used for the unit 'years', so that if a baby is 10 months old the phrase TEN MONTHS OLD must be used. Because these compounds are used only for people and animals, there is a limit to what age they can be used to talk about. '120 years old' is acceptable, because a person can live to this age, and if talking about a tortoise, '300 years old' signed in this way might be possible in theory. One cannot, however, sign 'one-thousand years old' in this way.

As Sutton-Spence and Woll have discussed above, 'hand at the chin' means 'pounds' when used in conjunction with a number handshape, so we have TEN POUNDS when the

handshape TEN is touched to the chin and then moved slightly away. As with the bound morpheme for age, there are limitations, and it can only be used up to £99. £100 must be signed with two separate signs as in ONE-HUNDRED POUNDS. Pence does not have a bound morpheme, and must be signed as a fingerspelled letter 'p'.

The bound morpheme 'hours' is signed with the number handshape making a circular movement at the wrist. The limitation here is that this can only be used up to 'ten hours'. 'Eleven hours', twelve hours', 'thirty hours', 'one-hundred hours', and so on, must all be signed with the number sign then the separate sign HOURS. There is another bound morpheme for time, and this is 'o'clock'. There are regional variations of this morpheme – in the Yorkshire area, the number sign TEN, for example, touches the side of the temple and then moves downwards in a twisting movement. Other areas just use the twisting movement in a general space in front of the signer, and do not touch the temple. The sign TEN-O'CLOCK can also be inflected to mean 'ten-ish' by changing the movement to a shaking movement (and adding an appropriate non-manual feature).

'Years ago' and 'years in the future' can also be talked about in BSL using a bound morpheme. 'TEN-YEARS-AGO' would be signed with the non-dominant hand held still with the index finger extended, and the dominant hand making the number handshape moving in a backwards circle starting and ending at the tip of the index finger. To sign 'TEN-YEARS-IN-THE-FUTURE', the movement becomes a forwards circle. This bound morpheme is only good up to TEN. The numbers up to TEN are handshapes held still, but after TEN they have movement of their own (ELEVEN, for example, is the thumb wiggling, in one regional variation), and so cannot be used with a bound morpheme that also requires movement.

In chapter seven the translation of assessments for deaf children will be discussed, but it is important to mention at this point that the sign TEN was considered carefully in these translations, and it was decided that TEN signed with both hands held up in the FIVE handshape (showing all ten fingers) was the most appropriate and clearest for this purpose. The assessment translations were also created with the aim that teachers in different regions would adapt them for their own use, and change the signs used to fit with the regional signs their pupils use.

Summary

This chapter has examined the use of certain handshapes for numbers in BSL and also taken a brief look at how number signs can be affected by regional variation. There are likely to be far more signs and variations for numbers used in the Deaf community than the few examples shown here, but they have not been documented or categorised. There is a dearth of research into actual signs and where and how they are used. It is important for native signers (like myself) to conduct more research into the variety of signs that are in use.

It is also of utmost importance that sign language is used in the teaching of maths to deaf children, so that they can make the connections between the numbers and other concepts they are learning and the handshapes and signs that go with them. Again, it would be a great advantage to these children to have a native signer teaching them mathematics.

Chapter 7

What were the issues involved in translating maths assessments from English to BSL?

"Translation, or the rewording of an original text, is found in many spheres and has been used as a way of transmitting culture and information and of communicating between cultures for thousands of years." Gresswell, E. (p50 2001).

The term 'translation' can refer to both the process (of translating) and the product (a translation). In the situation to be considered here, the original text is in English, and it is translated into a different language - British Sign Language, a visual gestural language. This involves reading the English text, and translating into British Sign Language, which is neither a spoken language nor a written language. The English text in this case is an assessment paper comprising of a series of questions. It is to be translated into British Sign Language for use by deaf pupils. This is an unusual situation – it is far more common to find translations from British Sign Language (BSL) into English spoken language. I led a team of language experts (both native signers and non-native signers) in completing this task and making a DVD to be used in to schools all over the United Kingdom.

The making of the DVD was a project funded by the Nuffield Foundation. The DVD was for use by pupils of base-line age, and years 2, 4 and 6. For the youngest age group (base-line) the assessment questions were to be presented on a computer screen, with the signed translation also on the screen, and the child would use the keyboard to record their responses. For years 2, 4 and 6 the DVD could be used in one of two ways: the

deaf pupil would watch the questions in BSL and also read the question in English, and then record their responses on an assessment paper, or, the DVD could be used as a guide for teachers in preparing their own live translations of the assessment questions in BSL (this would be the case in areas where regional variations of BSL are used, thus regional signs must be substituted for the signs used on the DVD). Regardless of how the DVD was used, the aim of providing it remains standardisation of the way the questions are asked in BSL. This is particularly important for a visual gestural language like BSL, because it is easy to give clues as to the answers to questions if one is not careful. I will discuss this in more depth later.

Britain's Deaf community uses a signed language with all the variation and variety inherent to spoken languages. The great variety in spoken English is, to a large extent, 'ironed out' by children learning to use a standardised written form of language. Deaf children using sign language learn their particular variety with its vocabulary differences. Regional variety in the way number vocabulary, especially, is signed creates difficulties for a nationally standardised assessment.

Little has been published of the knowledge and achievements of deaf children who prefer to use BSL. In terms of research the use of BSL in itself has been seen as a problem in assessments, although this does seem to be changing. Collins, Tate & Tymms. Deaf Worlds, Vol 19 (2003) p8. There is also a dearth of research into BSL as it is used in mathematics.

"... there is a shift away from language issues (modes of communication) to the quality of education on offer [...] Nevertheless, language issues still plague mathematics assessments, although some attention is now being devoted to the often bilingual or even

the multilingual nature of mathematics teaching and testing." (Powers, S. et, al. pp77-8, 1998).

The target language and culture for this assessment is an indigenous minority of Britain. It is aimed at those pupils who prefer to use BSL as their primary language and the language by which they most readily learn. The culture is that of Britain's Deaf community and the language is British Sign language. These children will grow up, to varying degrees, bilingual and bicultural in that they will also acquire the language and culture of the hearing majority.

> The degree of identification of these children with the Deaf community varies because of a number of factors: parental influences, school policies, and degree of hearing loss. Their parents themselves may be hearing or Deaf. They may have more or less positive or negative attitudes to the use of BSL. The school or Support Service may have a Sign-bilingual policy or they may not have a strongly defined policy but, nevertheless, use BSL with pupils for whom it is the preferred language. The degree of hearing loss is an important factor also in preferences to use a sign language. Tymms, P. Tate, G. Collins, J.(2001).

Part of the reason we were commissioned to produce assessment material in BSL was to influence school's policies around the use of BSL by parents and teachers of the deaf. It was important to demonstrate that BSL is an essential part of education if deaf children are to have the same access to their schooling as hearing children.

A standard translation was important because currently in the UK many Teachers of the Deaf (TOD) are hearing with BSL as a second or third language and with varying levels of fluency. This made it even more important to provide a very clear translation into BSL.

There are some Deaf adults who work with Teachers of the Deaf as role models, such as classroom assistants or Deaf Instructors. They would assist with sign language for hearing staff when they view the BSL DVD and adapt the translations provided, if necessary, substituting signs appropriate for the region. A set of rules for how to use the translations was created and sent out with the DVDs so that the translations are used appropriately by all the teachers. These rules should ensure that the translations are made relevant to pupils of different backgrounds, different understandings of sign language, and different situations in terms of whether they have Deaf staff working in their schools.

The most important outcome is that the assessment questions are presented clearly in BSL without any clues that would help deaf children to write the answers. In this way it assessed their knowledge of numbers and maths, in BSL, in a comparable way to assessment in English.

"There is no existing research relating to the process of translation between signed and spoken languages." Gresswell, E. (2001) p50. Since Gresswell made this claim, there has been research conducted about issues for sign language interpreters learning from translation theory (see for example, Napier, J. (2002) & Jones, C. (2006). There is only one study, however, that focuses on translation per se (the production of a target frozen text from a frozen source text) as opposed to the different issues for live interpreting.

'Assessment using BSL: Issues of translation for performance indicators in primary schools' by Collins, Tate & Tymms, (2003) was the first published in Deaf Worlds, and examines the same piece of translation work that I discuss here, focussing on a few selected examples of translation issues that were problematic in the work. This section will discuss their findings, as well as examine other examples of problems encountered in the translation work.

Transcription is the accepted method for compiling a data base for observation and experiments in language research. The problems connected with transcription are: high expense in time, access to data for analysis purposes, describes clearly the meaning, quality, quantity, and verifiability. For the purposes of this research, I will have to transcribe, into 'gloss', the BSL translations that were produced for the DVD. Using gloss, I will be able to discuss and compare different ways the assessment questions were, or could have been, translated into BSL. For example, gloss will allow me to look at questions of structure and sign order in BSL. Sign order in BSL is sometimes characterised as 'being flexible' – for instance, the question signs WHAT and WHEN, may occur at the beginning, middle, or end of a sentence. However, there are reasons this may happen rather than it being random.

...."translating is a text processing action where the role of the 'source text' as part of action theory becomes sub-sumed to the agents: sender, receiver, initiator, and translator. The relationship between 'source text' and 'target text' is understood in terms of intertexual and intratexual coherence. Intratexual coherence takes into consideration the target-culture receivers: it should be able to be understood by the receivers; it should be coherent within their communicative and cultural situation. The relationship with the source text, intertexual coherence, is one of 'fidelity' and this depends on the translator's interpretation of the source text". (Collins, Tate & Tymms, Deaf Worlds, Vol 19 (2003) p19.

During the translating process, the translator is continually actively making choices about ways of going about the translation, in our case, to ensure that deaf children clearly understand the questions.

> When translating a text, a translator has many things to consider. For example: the source readership (at whom the text is aimed and why): the context, content and meaning of the source text; the source culture settings and traditions; the text genre (type of text); the style and register of the text; and the language used in the text (for example, vocabulary, grammar and construction). They then have to relate all of these points of the target culture, considering things like by whom the text will be received and the linguistic differences of the source and target languages. Gresswell (2001) p 51.

Gresswell's comment is true, but our situation was slightly different to other translation contexts, because it was a document for use in the school system. The questions were fixed assessment questions and must remain so in the translation. Adhering to this need to maintain the standardisation was a priority for the translators, and meant there could not be a great deal of flexibility in adapting the questions to suit the 'target culture' (Deaf culture).

Translations were formed by asking these kinds of questions:

- What knowledge is the question attempting to assess?
- In what way does the question affect the preferred answer?
- In what ways can the answer demonstrate this knowledge?
- In what ways can the source in English text be changed into the target language - BSL?

When I first looked through the questions to prepare myself to translate into BSL, it started me thinking carefully about how to translate them clearly for Deaf children, so they could understand the questions, but without giving any clues or answers by the way the

questions were signed. There were many questions that were straightforward to translate, many that posed specifically language-related difficulties in translating, and some which were almost impossible to translate without giving the answer away. For example, signs for shapes are always visually motivated, and so could not be used if the answer required the pupil to know the shape. In these cases the English name for the shape had to be given instead, by finger-spelling or by holding up a card showing the English word. The translator therefore needed to make many decisions and was prepared in advance with the team. All decisions were agreed by the team to make sure we provided appropriate translations into BSL and that the assessment questions were clear.

> Linguists used to focus disproportionately on the fact that sign languages could use arbitrary signs. The existence of visually motivated signs suggested that sign languages were not real languages, as the lexicon was not totally arbitrary. Now we know that symbols do not have to be arbitrary in spoken languages because spoken languages are not designed to represent visual forms in the real world. They are able to reflect some sounds, but the names of sounds are only a small part of any language's lexicon, so most symbols are arbitrary. Sign languages do not need to rely so heavily on arbitrary symbols because they use the visual modality and many objects and actions have an obvious visual form. It would be unnatural for sign languages not to use visual symbols. The fact that all meanings are conventionalised is now considered more important than issues of arbitrariness. Sutton-Spence & Woll (1999) p166.

There are different levels of translations.

Here is an example from the BBC BSL Beginner's Guide (1988) a video clip of the signed sentence BOAT – WATER OVER DEEP HIGH (capital letters are used to write 'glosses'

of the signs used in a BSL sentence). These two different English sentences are both possible translations:

1. A huge wave covered the ship.

2. A huge wave, at least five times the size of the ship, loomed up on the starboard side, crashed down, rolled the ship over and drove it below the waves.

While the first captures the basic or 'surface' meaning of the signed sentence, the second sentence would be a more accurate and 'deeper' translation.

Sometimes the source English texts were translated into target BSL with some influence of English word order or a fingerspelled English word when needed, such as the word 'circle'. The signs CIRCLE, SQUARE and TRIANGLE are articulated as if drawing the outline of the shape in the air with the index finger handshape, and these signs needed to be avoided. Some English sentences however can translated well into BSL structure, and signs that do not give away visual cues could be used, such as 'SHAPE' (handshape 5).

SHAPE (one handed)

SHAPE (two handed)

I will now show some examples of questions from the four different assessment levels and discuss how a translation was created for each question.

1.Baseline

2. Year 2

3. Year 6

Baseline DVD Ideas about Maths

Baseline assessment is an assessment of children as they start school and this is repeated in an extended form almost one year later. The assessments, which form part of the PIPS (Performance Indicators in Primary Schools) project, run from the Curriculum Evaluation and Management (CEM) Centre at Durham University. The PIPS baseline is the most widely used baseline in England and is available in two parallel forms – a text based version in which the teachers work with the child on a booklet and a computer based version in which the two work in front of the computer screen. The great majority of the assessments of deaf pupil were assessed with the text version.

> The assessments have been adapted for use with deaf children. Recognising that one cannot meaningfully assess a child unless good communication is established the adaptation involved providing teachers with guidance was provided to schools engaged in using an oral approach to the education of deaf children. Schools using bi-lingual approach (i.e. involving the use of British Sign Language and English) were provided with written and signed guidance (the latter on videotape / DVD in British Sign Language). No changes were made to the content of the assessment. Tymms, P. Brien, D. Merrell, C. Collins, J. Jones, P. (2003). Young Deaf children and the prediction of Reading and Maths.

> The PIPS baseline is extensive in its coverage and it was therefore possible to create a meaningful measure after omitting the parts that were considered inappropriate for young deaf children. Accordingly a prior measure was constructed by adding together the scores on: Name writing, ideas about reading, letter identification, ideas about maths, counting sums (without symbols) and digit identification. Each of these items can be presented in the child's preferred language (spoken or signed), without compromising the fundamental nature of the questions. Tymms, P. Brien, D. Merrell, C. Collins, J. Jones, P. (2003). Young Deaf children and the prediction of Reading and Maths.

I was involved in this project as a consultant and in discussions with the team about some of the questions in the PIPS assessment booklet were appropriate for deaf children. We agreed with the CEM Centre that we would translate the questions in the assessment booklet and that this would be sent out to both deaf schools and mainstream schools with deaf pupils so that deaf children would have the same access as hearing children to assessments. Since the project was completed, I have looked again at some of the translations and issues that arose for the translators. More details will follow about what I have found.

> The content of the assessment: Both the 'English vocabulary' and the 'Phonics' sections were originally conceived as being administered using spoken English. We provided instructions on how the vocabulary section could be presented using finger spelling, lip speaking or written words. But both of these sections may be regarded as inappropriate for certain severely and profoundly deaf children at the age of four. Tymms, P. Brien, D. Merrell, C. Collins, J. Jones, P. (2003). Young Deaf children and the prediction of Reading and Maths.

Variable	Description
Writing	Writing child's own name. Quality of writing scored on 0-5 scale.
IAR	Ideas about reading assessing concepts about print.
English vocabulary	Objects within scenes identified.
Phonics	Rhyme detection.
Letter identification	Identification of first letter of child's first name and then a series of upper and lower case letters.
Advanced reading	Word identification, and then reading sentences and passages.
IAM	Ideas about maths assessing concepts such as size and capacity.
Counting	4 and 7 objects counted and then recalled.
Sums	Simple sums that did not include symbols.
Digit identification	Identification of single, double and triple digits.
Advanced mathematics	Number problems and calculations including symbols.

We translated all these and provided an explanation to deaf pupils at the beginning of the video and the DVD to ensure they understood what was expected before the questions started. We also provided examples of what we wanted them to do, before they started to open their assessment booklets. For example, we explained that they must use a pencil and write the answers clearly, and if they made a mistake or changed their mind, they could rub it out and write it again. This was important so that their answers could be read clearly and accurate data collected about their results.

Questions form Baseline Level:

Baseline is level for four/five year old pupils and is their first assessment in the series of ongoing assessments at years 2, 4 and 6. An example of assessment (4/5 years olds) asks the following questions.

'Which bottle will hold the most water?'

In BSL, the best choice of sign for MOST in this sentence would be a visually motivated sign which uses two hands to pulling apart from each other vertically as if indicating a rise in water level in a container. While this sign is the best choice, it could not be used for these assessment questions, as it gave away too many visual clues. The question was adapted, and a non-visually motivated sign MOST (index fingers brushing past each other) was used instead. A back-translation of the adapted original is:

'Water is poured from a jug into three bottles. Which has the most water?'
(This is not a written version of the BSL text. BSL has no commonly used written form.)

This translation conveys the intention of the original text producer, to assess understanding of the concept of 'most'.

The same thing happened with the next question: 'Which bottle will hold the least water?' A non-visually motivated sign for LEAST had to be used.

In primary schools, deaf children can easily come to understand the concepts of 'most' and 'less', for example, if signs are used. The visual nature of some signs gives them clues as to the meanings. (For example, MOST can be signed with spread hands, palms facing each other, then the hands move apart to indicate something larger is between them. LEAST is signed with hands apart, facing each other, with two fingers extended from a fist ('H' handshape). They move downwards and together to indicate the space between them is diminishing).

Signs can be adapted not to give extra visual information to do with size and so on. The BSL/English dictionary lists such 'alternative signs'. (For example, MOST is usually

signed with two index fingers, both pointing away from the body, one in front of the other. They are then rubbed once along each other to finish with the other hand in front. This is more of an abstract sign that doesn't contain any information about size. LEAST creates more of a problem - there is no alternative to the sign described above, but it can be inflected to make the movement much more subtle, or a different handshape used (thumbs instead of the 'H' handshape) in an attempt to avoid giving away information about its meaning. This would depend on the context in which it was being used. This is only a problem when teachers want to test understanding of the English word 'least.' It's meaning is a mathematical concept at base. In our translation of the question 'Which bottle will hold the least water?' any sign that indicated something getting smaller could not be used. Instead of any of these versions of LEAST, a more abstract sign had to be chosen, and it was decided to use a sign that means 'little' for this question.

	
MOST	LITTLE

The Question: The BSL translations of the questions.

"Which bottle will hold the most water?" / "Which bottle will hold the least water?"

The BSL vocabulary chosen for the questions can be glossed as MOST WATER / LITTLE WATER as comparatives in parallel with the English words 'most water' and 'least water'.

The adaptations of these questions are designed for the purpose of accessing similar knowledge in BSL (early mathematical knowledge) as the questions in English are designed to access. BSL vocabulary is chosen to make sure the questions are closed (MOST WATER/LITTLE WATER).

I have already mentioned the choice of the sign LITTLE over the sign for LESS. LITTLE is a more abstract sign. There are visually motivated signs for 'most' and 'less' that give away clues as to the meaning, so the abstract signs MOST and LITTLE are better choices. While the visually motivated signs would be parallel to the English words 'most' and 'least', the iconic features of some BSL constructions have to be taken into consideration, and abstract concepts used rather than visual concepts. In this instance, a measure of inter-textual coherence has been achieved.

However, in the phrase "Which bottle will hold the most water?" the sign HOLD poses another problem. How should this be adapted for intra-textual coherence? The sign HOLD is used in BSL only for handling and grasping contexts (things that can be held in the hands). Water cannot be held in this way, so the sign HOLD is not appropriate. The translation shows water being poured into bottles, so it is obvious that the water is *in* the bottles. As can be seen below, the sign HOLD is not needed.

BOTTLES (POINT X 3) WATER POUR (X 3) WHICH MOST (signed in the abstract way) WATER?

The English question is constructed as an interrogative, and this is indicated by the first word in the sentence, "which". Most commonly in BSL, the question word would come at the end of the sentence, as in:

BOTTLE HOLD MOST WATER WHICH?

Because of the problem with the concept 'hold', and the need to circumnavigate this, the sign order of the sentence was affected and is somewhat unusual, although still acceptable in BSL.

BOTTLES (POINT X 3) WATER POUR (X 3) WHICH MOST (signed in the abstract way) WATER?

The next question would be similar:

BOTTLES (POINT X 3) WATER POUR (X 3) WHICH LITTLE (not LEAST) WATER?

These are preferable adaptations of the questions, rather than

THREE BOTTLES (POINT X 3) WATER POUR WHICH MOST (signed in a way that indicates a greater or smaller amount of a substance in an upright receptacle).

However, on reflection and upon studying the back-translations of the translations that were put on the DVD, I can now suggest a translation that does not give away any visual clues, but also adheres to the most common position in BSL for the question word:

THREE BOTTLES (POINT X 3) WATER POUR (X 3) MOST WHICH?

THREE BOTTLES (POINT X 3) WATER POUR (X 3) LITTLE WHICH?

(The DVDs have already been recorded and sent out for use in schools, therefore correcting this translation will not be possible until such time as the assessment questions are changed and a new DVD is created).

Decisions have to be made about whether an equivalent sign will be looked for English words, bearing in mind that extra information that is not in the English text should not be added to the translation. Therefore, sometimes an English word must be fingerspelled in the translation to make sure the two versions of the question are equivalent.

Before translations are considered, the purpose and meaning of the questions needs to be discussed. Answers to these issues will affect how the translations are carried out. The translator needs to think about these things before beginning to translate assessment questions from written English into BSL.

> The written questions (presented in spoken English to other pupils) assess a level of understanding of the language (in this case English) as well as the conversation/mathematical concept. The translations must assess a level of understanding of the language (in this case BSL) as well as the conversation/mathematical concept: the language and the mathematical reasoning come as one. Teachers left to decide how to translate the questions for themselves will use their knowledge of teaching the child plus their knowledge and skills in BSL. (Collins, Tate & Tymms (2003) Deaf Worlds vol 19, no 1 p12.

The questions assess a level of understanding of the language (in this case English) as well as the conservation/mathematical concept. Teachers regularly using spoken English with visual support (SSE or a signing system) may decide to use signs or gestures, which visually negate the question's assessment of the language plus the concept: a borrowed

sign or gesture, which is visually motivated by comparative size and volume, may be used. This would not produce an accurate assessment of the pupil's knowledge of the concept/English. Teachers regularly using BSL with a pupil may also use the same strategy without a question model. Again, this would not produce an accurate assessment of the pupil's knowledge of the concept/BSL.

> Several Deaf adults have told us that they regularly have discussions with their deaf children about the "correctness" of a certain sign. These deaf children have come home and told their Deaf parents that the sign the parents use is wrong because the teacher at school taught them another one – the "correct one." Some Deaf adults have explicitly told us that they feel that the signs their children were taught at school (i.e., the high variety) are better than their own sign (i.e., the low variety). This is consistent with attitudes found in other Deaf community. (Herreweghe, M. V. & Vermeerbergen (2004) p118).

This is also consistent with my own experience working in a mainstream primary school with deaf pupils in Leeds. On one occasion, I signed a story to the children, in which I used the sign JUMPER, which I signed on the body in the way commonly used by the Deaf community. Later, I witnessed the children repeating the story to each other, but using a different sign for JUMPER, one that was signed as if pulling a jumper over the head. When I questioned their use of this sign, they told me I had been using the 'wrong' sign, and that their teacher (a hearing Teacher of the Deaf) had given them the 'right' sign. I politely explained to the children that I was a native signer who had been using sign language since birth, and that their teacher was a hearing person who was still learning to sign, and that the sign I had given them was indeed correct in BSL. I also had to approach the teacher and diplomatically question where she had got that unusual sign for JUMPER. It seemed she had created it herself for use with young deaf children. What is

interesting here is that deaf children were inclined to label the signs their hearing teachers used as 'right', possibly because they were already used to the idea that hearing people have power in the world rather than Deaf people, or simply because children tend to accept their teacher's language as standard and preferable. I have also seen examples of deaf children going home to their Deaf parents and correcting their parents' signing. These examples show the power hearing people have had to influence the native language of the Deaf community.

> There remains a vast ignorance in the hearing world about the nature of signed language, and this ignorance all too often results in negative views of both sign languages and the people who use them. Sadly, such views are often internalized both by individual deaf people and by deaf communities as well, resulting in diglossic language communities in which natural sign languages are perceived to be the "low" variety of signing, while those more closely paralleling the surrounding spoken language are seen as the "high" language variety. (Stokoe (1970) and Deuchar (1977) in Reagan (1995) p. 137).

Although often used by Teachers of the Deaf both in the past and today, Signed English has never been a great success with adult sign language users. When deaf children are taught in school with signed English, they still produce in BSL naturally. They never communicate to each other in Signed English because it is not a natural way for them to communicate. They only they use it in class with their teachers.

I will now use selected Baseline questions from DVD to examine issues of 'formal' versus 'dynamic' translation.

The comparison of texts in different languages inevitably involves a theory of equivalence. Equivalence can be said to be the central issue in translation although its definition, relevance, and applicability within the field of translation theory have caused heated controversy, and many different theories of the concept of equivalence have been elaborated in the past fifty years.

Nida argued that there are two different types of equivalence, namely formal equivalence (which is also referred to as formal correspondence) and dynamic equivalence. Formal correspondence 'focuses attention on the message itself, in both form and content', unlike dynamic equivalence which is based upon 'the principle of equivalent effect'. Nida, E. Principles of Correspondence. (2003) pp129:130).

Dynamic translation (D-E) the focus is toward receptor response: the aim is for a native user of the target language to feel the text is natural and not even a translation. However it is still a translation from the original text and therefore must clearly reflect the meaning and intent of the source language text.

Most of the translations on the DVD aim for dynamic equivalence, but in the cases where signs could not be used because they were visually motivated, and concepts had to be fingerspelled in English instead, formal equivalence could be said to be the outcome. Fingerspelling in cases like this is a version of an English word. Each letter is spelled out on the fingers clearly. This is not BSL, and is different from cases where fingerspelled words have become BSL signs (as in the case of name signs for places, e.g. DURHAM, which is spelled d-h-m with an extra flourish). In formal equivalence word order may not be adjusted, so BSL signs are signed in an English order, and meanings are taken from the source context and not adjusted for the target language (BSL).

'..... the term equivalence is adopted in this book for the sake of convenience – because most translators are used to it rather than because it has any theoretical status. {...{ although equivalence can usually be obtained to some extent, it is influenced by a variety of linguistic and cultural factors and is therefore always relative'. Baker, M. in other words: a coursebook on translation (1992) pp5-6.

It is possible to recreate any written English word by fingerspelling, with twenty-six hand-arrangements corresponding to the twenty-six letters of the English alphabet. By using these, fingerspellers can produce the spelling of an English word on their hands. Fingerspelling is not BSL though, because it does not use BSL vocabulary. Sutton-Spence, R. & Woll, B. (1999: p17).

It is possible to fingerspell for b-i-g-g-e-s-t but for shape I fingerspelt c-i-r-c-l-e clearly. I have to fingerspell clearly or I could fingerspell movement in more-like BSL. But this is not English testing when fingerspell B-I-G-G-E-S-T or S-M-A-L-L-E-S-T according to hearing sound 'est' in English.

'In BSL we can find such examples in CLUB, PROJECT, ABOUT and CELTIC where there is an almost total reduction of the vowels and changes in orientation and positioning of the other letters. Each form is articulated in a single flowing movement. Brennan, M. Visual World of BSL. (1992) pp92,93.

Questions (some of these questions refer to pictures which are shown on a computer screen next positioned next to the signer in the DVD).

1. Can you show me the biggest cat?

Translation: SHOW ME CAT BIGGEST WHICH?

This is another example of a question in which the sign for the concept that is being tested (biggest) is visually motivated and had to be adapted so as not to give the concept away. In the translation BIGGEST was signed with a small movement rather than the typical large movement. BIGGEST would normally have some non-manual features (facial expressions) that go with the sign: typically a puffed up cheek and wide eyes or lips making a 'shhhh' shape may be used to emphasize the concept of bigness. In the translation these non-manual features were made more subtle, again to avoid giving clues. The word order was changed to grammatically correct BSL with the interrogative WHICH coming at the end of the sentence, but overall I would describe this translation as a formal rather than a dynamic translation, because of the adaption of the sign BIGGEST.

Non-manual features are actions of the head, face or body which are exploited in some way within the grammar and lexis of BSL. Whilst such features play a major role within the syntax of BSL, they may also have some function within BSL vocabulary. Brennan, M. Visual World of BSL. (1992) p31.

These questions are testing the pupil's knowledge of the concepts 'biggest' and 'smallest'. This requires the pupils to know the meaning of the superlative morpheme **'est'.** Hearing children would hear this morpheme added to 'big' and understand the concept of 'biggest'. On reviewing the translations, I can now suggest that a more dynamic translation would have been to sign WORSE BIG and WORSE SMALL, or BIG MORE and BIG SMALL. WORSE in BSL has a different meaning than in English. It does not mean, in this context, that something is of a poorer quality, rather it is used in the same way as the morpheme 'est' and can have positive meanings too, as in WORSE CROWD at a party or protest. It can change the meaning of an adjective, as in WORSE FAT (obese). WORSE is a

vocabulary item acquired naturally when children are exposed to fluent or native signers. (It could be analyzed as a combination of free and bound morphemes: the sign meaning BAD, 2-handed contact, and the bound morpheme of movement apart in neutral space meaning 'even more').

Although BSL is independent of English, it has been influenced by English, and has borrowed from English. One of the things it has borrowed is the mouth patterns from English words. BSL has not just borrowed randomly, though, and there are times when English mouth patterns are borrowed, and times when they are not. More importantly, BSL changes the English mouth patterns, so that when they are used, they are not always used as they are in English. Sutton-Spence, R. & Woll, B. (1999) p81.

English mouth patterns are borrowed I have given a lot on DVD with numbers such as two, three, four, five, six, eleven, twelve, twenty also 'shape'.

It is not always easy (or desirable) to separate oral components in BSL from information given on the rest of the face. We will now consider information carried on the rest of the face that may be phonologically or grammatically important. Important parts of facial expression to note here are the actions of the cheeks, brows, eyelids, and eye gaze.
Facial expression may have several functions, including lexical distinctions (obligatory for some signs), to mark questions, to mark topics, to mark conditionals ('if'), and to show emotional state. Sutton-Spence, R. & Woll, B. (1999) p81.

2. Can you show me the smallest cat?

Translation: SHOW ME WHICH CAT SMALLEST?

Again, the sign SMALLEST was signed with a more subtle movement than is normally used, and non-manual features were dropped. In this translation, however, the interrogative WHICH comes in the middle of the sentence, and a facial expression was used with the sign WHICH to emphasise that this is what the question was asking. This was done simply to create some variety in the way the questions were asked. Sign order is flexible in BSL and the meaning here is the same as if the interrogative was placed at the end of the sentence.

3. Who is holding more balloons? (This question comes with a picture of some cartoon characters that look like apple pips each holding a number of balloons).

Translation: PIPS HOLD BALLOONS - MORE WHICH?

The question in English uses the interrogative 'who', which was replaced with the sign PIPS in the translation, to relate the question to the picture. The sign MORE was articulated with a clear English lip pattern, which reinforced that this was what the question was focussed on. WHICH falls at the end of the sentence in accordance with BSL sign order.

I didn't signed the question' who'? as said on English sentence. I signed PIPS to add. I signed which because it was on the computer screen with appropriate with picture and signed for MORE with English lip pattern. Reinforced 'more which' in the end of sentence.

4. Who is the tallest? (Relating to a picture of three people of different heights.)

Translation: Pointed these - 1 x 3 – THREE PEOPLE (point to screen) WHO TALLEST WHICH?

The sign TALLEST had to be adapted in this translation, because it is visually motivated and easily gives away the concept of tallness or height. Here, it was signed with a more subtle movement and facial expression than would normally be used. The sign PEOPLE and the point to the screen were added to the sentence to help link the question to the picture on the screen. Ending the question with the sign WHICH stresses that the pupil must choose one, and is more appropriate for this type of question than WHO in BSL.

5. Who is shortest?

Translation: ix SHORTEST WHO – WHICH? (in transcription, 'ix' refers to the index finger referencing something).

As above with TALLEST, SHORTEST had to be adapted to be less visually motivated. WHICH was signed in front of the picture on the computer screen. Similarly to the concepts of biggest and smallest, in a more dynamic translation, tallest and shortest may have been signed WORSE TALL and WORSE SHORT.

Sums A

The English version reads:

Question: Here are three beach balls.

If I took one away, how many would I have left?

This could be signed in BSL as:

IF THREE BALLS (NUMBER PRONOUN 3 HELD ON PASSIVE HAND) TAKE AWAY ONE (CHANGES TO NUMBER PRONOUN 2 ON PASSIVE HAND) HOW MANY LEFT

Because there are two fingers left on the passive hand, a pupil would immediately see the number two as part of the question! It is very easy in translation to make the question redundant if it is not interrogated for meaning and compared to the original for its purpose. Some abstract mathematical reasoning on the part of the child is needed for the English version. The translation aimed for the same.

The visual nature of BSL means that care is needed when signing assessment questions. Using fingers to reinforce that there are 3 balls, then taking away one of the 'fingers', which is one correct way of presenting this question in BSL, makes the answer obvious. The question must be signed without use of the pronoun forms for the numbers. If it is to match the purpose of the question in the source language.

A better translation would be to refer to the three balls on the screen (as the English question does in the phrase, 'Here are ..') and not sign the balls in signing space. Next sign TAKE-AWAY ONE, in neutral space. This avoids additional location information being used and only the information on the screen is available. The child is then asked 'how many are left' (in BSL). Therefore a BSL model question was created in the same way that the question was carefully worded in English and adhered to regardless of whether the child is presented the question in written or spoken English.

Question: Here are 4 cars. If you took one away how many would be left?

Translation: 4 CAR (refer to screen) TAKE-AWAY 1 HOW-MANY LEFT?

In a similar way to the '3 balls' question above, the four cars are seen on the computer screen and 'Here are ...' is the reference to them. The same formula is used to create the translation. A classifier proform is not needed as CAR is pluralized by the separate number FOUR and reference to the screen drawings. This is another example of a question where the use of plural proforms had to be avoided in the translation, to avoid giving away the answer by information being present in location morphemes. After the noun CAR was signed the cars were simply referred to by pointing to the computer screen, then TAKE-AWAY ONE, HOW-MANY LEFT?

Question: Here are two rabbits. If you put one more rabbit in the picture how many would there be?

Translation: 2 RABBITS (refer to screen) ONE-MORE RABBIT ADD (signed by a holding 'C' handshape moving to the screen) HOW-MANY THERE? (signed in location near screen)

Here again, the picture on the computer screen is referred to in the BSL sentence. BSL signs can be signed in different locations, and in this case it was clearest to use a 'C' handshape (as if holding a rabbit in the hand) to 'add' a rabbit to the picture on the screen. Also, the sign THERE was signed right in front of the picture.

Question: Here are 2 puppies. If you put two more puppies in the picture how many would there be?

Translation: 2 PUPPY (refer two puppies on screen), TWO-MORE PUPPY-GO-WITH (signed by 2 x 'H' handshapes jumping towards the screen) HOW-MANY THERE? (signed in location near screen)

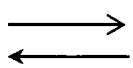
The main formational difference here to the previous question is that the objects (the puppies) is signed as jumping themselves to join the others on the screen (and not being placed as with 2 handling/grasping classifiers). The JUMPING proform for PUPPY avoided giving number information. This would not alter the main purpose of the original English question about the mathematical concept of addition. The issue here was deeper understanding the concept of plurality in BSL. The PUPPY only jumped to the screen once. The number of puppies jumping to the screen was previously established by the sign TWO-MORE. The translation above avoids this problem.

Question: Which shape is a circle?

For these questions, different shapes are presented on the screen (a circle, square, triangle, parallelogram) and the pupil has to point to the correct shape. (see previous discussion of this in chapter 5). These questions are translated into BSL by referring to the English word (eg 'circle') in the sentence, and asking the pupil to pick out which of the shapes on the screen it refers to.

The translation can be glossed as:

index (circle) WHICH



Assessment Year 2

Maths Quiz

The subjects assessed at Year 2 are Reading and Mathematics. For this research I will look into Mathematics. There is little precedent for this kind of translation and thus little knowledge to draw on when creating translations for deaf pupils who prefer to use BSL.

Year 2 questions - some examples:

Question: What is half of 18?

Translation: EIGHTEEN HALF (IX) WHAT

IX in gloss refers to using the index finger to point to or 'reference' something. Here it is used to point to the space where the HALF was signed, so in effect pointing to the 'half'. This was important in this translation to make it clear that it was the half of the eighteen that was being asked about and a questioning facial expression is used simultaneously with the referencing.

The sign WHAT comes at the end of the sentence in accordance with BSL structures for questions. WHAT is signed with a wagging index finger and the non-manual feature (facial expression) of lowered eyebrows.

Question: What is 2 lots of 2?

Translation: 2 (location) 2 (location) ALL TOGETHER WHAT (IX) THEN TICK IN BOX.

Here, the sign TWO was articulated in two different locations in space, with two different hands, to indicate two separate 'lots' of two. The sign ALL-TOGETHER is articulated with both hands that move together to meet in the middle, this central space is then referenced with an index finger to show that it is this total that is what is being asked about.

Three Questions are about a drawing on the page of a simple bar graph with a short text in written English as follows: 'Ruth makes a graph of the colour of cars passing the school each hour.'

Translation: SEE GRAPH (refer to graph) GIRL NAME r-u-t-h (IX) BEEN COUNT CAR proform-CAR-PASS +++ iterative aspect (purse lips to indicate speed) SCHOOL proform-SCHOOL (5 handshape loc) proform-CAR-PASS-SCHOOL COLOUR CAR MAKE WHAT? GRAPH COLUMN loc loc loc NUMBER loc loc loc (A handshape lists) UPWARD pause BLUE loc NEXT-loc RED NEXT-loc BLACK NEXT-loc GREEN HOUR++ CAR PASS (IX) PERSON-WRITE++.

> A clear definition of the more specific concept of classifier has been given by Clayton Valli and Ceil Lucas; 'A classifier is a handshape that is combined with location, orientation, movement and non-manual features to form a predicate. It is a symbol for a class of objects.' In 'The car went past', the subject is CAR and the predicate is Veh-CL-PASS. The classifier handshape is a flat hand, with palm facing down. The same handshape would be used with any motorised four-wheeled vehicle. Sutton-Spence, R. & Woll, B. (1999:48).

This is relevant to how I signed CAR in this translation. I used a classifier proform with repeated movement to show the plural of CAR+++ passing the school. In order to translate the introductory text in preparation for the following questions, a knowledge of BSL grammatical construction is crucial for the producer. The Deaf pupil then has the opportunity to understand the questions and relate to the task in the following questions to be able to work out the response. I would like to make the claim that grammatical knowledge of the language is directly implicated in mathematical reasoning – in any

language. I believe the previous translation examples have also demonstrated evidence of this claim.

The first follow-up question: 'Ruth counted more red cars than green cars. How many more?'

1 2 3 4

(the pupil must be directed to circle one of 1 2 3 4)

Translation: refer-loc r-u-t-h refer-loc COUNT CAR RED refer-loc MORE-affirmative (head-nod) BAR-GRAPH-MEASURE COMPARE ('than') LOWER-DOWN-BAR-loc GREEN (left loc) RED (right loc) HOW-MANY MORE? pause ONE? (refer answer choice on paper) TWO? (refer answer choice on paper) THREE? (refer answer choice on paper) FOUR? (refer answer choice on paper) TICK

In this translation, a non-manual feature (a facial expression and leaning forward from the neck) was used with the final sign TICK to emphasize what was required of the pupil in the answer – a number. The question sentence ended with the interrogative HOW-MANY MORE? It was not signed in neutral space and referenced explicitly to the spacial location of the red column but this was not necessary as the sentence construction already included the comparison of the different heights of the bars. The reference for the final question had already been given. The mathematical reasoning again comes out of understanding of the grammar. I would like to put this alongside the assertion that understanding of the written (or spoken) English grammar is also a prerequisite of understanding the mathematical task when asked in English.

Question: Which of these shapes is symmetrical?

Translation: SHAPE ('5' handshape location) SYMMETRICAL (B B movement book) WHICH?

Here, the translator gives the sign SYMMETRICAL with a clear articulation of the English lip pattern for the word. This adds clarity for the deaf pupils of an abstract sign, and the facial expression (one of confirmation) also helps.

This is a dynamic translation suitable for an assessment question. A dynamic translation might, as well as or instead of using the sign SYMMETRICAL, explain the concept of symmetrical (e.g. by drawing two shapes in the air and signing SAME, etc.) rather than using the fingerspelled English word.

Question: Jane has 12 sweets to share equally between herself and three friends. How many sweets will each person get?

Translation: 12 SWEETS (lumped on hand 'location') SHARE EQUAL THREE CHILDREN (loc x 3) GAVE 3 (reference points x 3) HOW MANY HAVE.

In the translation, the name 'Jane' was dropped. The translator felt that in this question the name of the person and the fact the sweets were shared with friends were irrelevant to the concept being tested, and that it was more important to focus on the sweets and the sharing. Indexing was used to refer back to the location of each child in the second part of the question.

Question: Write the number nine hundred and three.

Translation: WRITE NUMBER NINE HUNDRED THREE – BOX.

In this translation the way 900 was signed was important. 900 can be signed in BSL either by articulating each digit in the number – 9-0-0, or by using the sign for 9 followed by a handshape and movement that designate 'hundreds'. This was important because the question is testing understanding of the concept of 'hundreds' (see Chapter 6 for more discussion of this).

Question: Which shape is the square pyramid?
Translation: SHAPE – WHICH s-q-u-a-r-e p-y-r-a-m-i-d (this was fingerspelled, but showing a flash-card would also work).

In this translation, signing SQUARE PYRAMID had to be avoided. Rather, the English word had to be used, either by finger-spelling, or by showing it on a flash-card. SHAPE and WHICH could be given in BSL, and WHICH was signed with the accompanying facial expression.

Question: "Which one is a star/circle/square/triangle/hexagon/?"

This question can be redundant in BSL, and needs to be adapted, because it is really asking if children know the English word for each shape (either written or finger-spelt).

Asking in BSL "which one is a star?" would work, because there is a sign STAR that is not based on the shape of a star. However, the signs CIRCLE, SQUARE, TRIANGLE, and HEXAGON are all visually motivated, that is, they are based on the actual outlines of the shapes. In signing these questions, one would be giving away the answers. To create an equivalent question in BSL one would have to show the child the written English word for each shape on a flash-card, or fingerspell them.

Bassnett's interpretation of Sapir and Whorf's theory is that:

> No language can exist unless it is steeped in the context of culture; and no culture can exist which does not have at its centre, the structure of natural language. Language, then, is the heart within body of culture, and it is the interaction between the two that results in the continuation of life-energy. In the same way that the surgeon, opening the heart, cannot neglect the body that surrounds it, so the translator treats the text in isolation from the culture at his peril. Bassnett, S. 'Translation Studies'.1991: p.14.

Deaf people are native users of BSL who embody the natural structures of the language, and as such are the body that the heart surgeon must not neglect when operating. Deaf people are the experts at interacting between the two languages of BSL and English, even if, as is often the case, they do not have a perfect command of English (which is hard to master as it is a spoken language).

> There are three types of translation, according to Jakobson (cited in Bassnett-McGuire 1980; and in Gentzler 1993): intralingual translation (the rewording of a text within one language); interlingual translation (the transfer of a text from one language into another); and intersemiotic translation (the transfer of a text into a 'nonverbal sign system' such as music or dance). This study concerns itself with interlingual translation. Gresswell, E. (2001) p50.

In my view it is not appropriate to talk about 'verbal signs' when discussing BSL. BSL is not a verbal language because it is not based on sound and/or spoken language. Deaf people do interlingual translations, or rewording, when appropriate, for example in a

setting such as this assessment DVD where every question is signed for Deaf pupils. Deaf adults working in schools will also do intralingual translations when they reword the translations on the DVD using their regional signs, because they are using the same language, BSL.

Interlingual translation occurs where the assessment questions are translated from written English written into signed BSL (a visual language). Nida's model of the translation process illustrates the stages involved: the source language as a text is encoded, the message is received and then recoded as words (output), it is analysed and transferred (restructured) as a translation in the receptor (BSL).

An example of this is the translation of the question about which of three bottles would hold more water. The signed sentence starts: WATER IS POURED FROM A JUG INTO THREE BOTTLES... The non-manual features used with the sign POUR are important here – a puffed out cheek as the sign is being articulated. The puffed out cheek can then be exaggerated in the final part of the question to incorporate the concept of 'most', and WHICH can be signed after the choices of bottles are established.

The adaptation can be seen as a way "decentring" the construct: reviewing the definition of the source text to be able to construct an adapted text suitable and accommodating of this language and cultural group. {A 'literal' translation of a 'bottle holding' is nonsensical or humorous in a signed language).

"Water is poured from a jug into three bottles. Which has the most water?"

This conveys the intention of the original text producer, to assess understanding of the concept; the above is a back-translation in English for the purpose of assessing

intertexual cohesion – a measure of fidelity. It is not a written version of the BSL text (BSL has no commonly used written form).

> English vocabulary items are ones specific to the syllabus (and therefore would have been taught, e.g. 'square', 'circle', 'acute', etc) and not ones for which a decision for an equivalent has to be made. Meaningless translations are more an issue in terms of ensuring BSL syntax and grammar asks a parallel, adapted question as in the source language, i.e. one that is also guided by the knowledge it is attempting to elicit. Collins, Tate & Tymms Deaf Worlds Vol 19 (2003) p.21.

Another question that comes up when translating maths questions into BSL is the issue of written English, and the visual-spatial nature of some maths problems. It is very important that locations in the BSL question are referenced with eye-gaze. Here is an example:

Year 4 Maths Quiz

Year 4 assessments are created by combining questions from both year 2 and Year 6 assessments. The following are a selection of these.

Question: 699 children go into a building. If one more child goes into the building, how many will be inside now?

Translation: (5 - all fingers extended and spread) loc BUILDING BIG (SASS NMF) ('5' - (Location) reference same placement) BUILDING CHILDREN QUEUE (line NMF) IX these SIX HUNDRED NINETY NINE IN BUILDING (back to same location '5' handshape) (Time line for a while) ONE MORE CAME ALONG IN (these) HOW MANY (of these group together).

The translation included the 'big' NMF which was not part of the original question in English. In BSL it is important to show that the building is big enough to hold all those children. Also, a reference point to the location of the building was used and this is important to show exactly where the children are. In BSL one does not need to sign ONE MORE CHILD, as it has already been established that the ONE MORE refers to children, so the listener would assume that is children that are being added.

> Classifier predicate handshape morphemes may include Whole Entity, Handling, and Extension. In a Whole Entity-CL the handshape represents a whole referent. This may be in terms of features (such as 'animate' or 'human'); or in terms of its dimensions or shape (also called Size and Shape Specifies). In a Handling-CL, the handshape shows the configuration of the hand as it moves, uses or tracks an object or part of an object. Extension-CLs trace the shape of an object and include handshapes used to represent surface areas. Sutton-Spence, R. & Woll, B. (1999:49).

Question: Think of the number 5. Add 2 to it, then add 2 to it again and then again. What number do you get?

Translation: YOU THINK (visualise) NUMBER 5 (eye-gaze moves upward toward location of the '5') ADD TWO (IX (refer by pointing) to same location, then move back to neutral signing space) ADD 2 (IX same location and back to neutral signing space again) ADD 2 (then back to neutral space then ix neutral place) AGAIN (IX) YOU THINK ALL (location of original number 5) ALTOGETHER HOW MANY?

Eye gaze is very important in sign language to refer to the location of things, for reference points and in role shift.

> Eye gaze has at least five important uses in BSL; at the phonological level for lexical distinctions; in conjunction with location and movement of referents in space; to show 'role shift'; to contrast pseudo-questions (rhetorical and echo) with genuine questions; and for marking time. Sutton-Spence, R. & Woll, B. (1999:94).

In BSL it is important to use eye gaze to refer back to a location where something has been established. This is a little bit different to how it is used in the year 6 question discussed below. In English one can just say 'think of a number' but in BSL the sign VISUALISE is used, because it allows the signer to refer back to the place near the head where the visualisation is placed.

Question: A coin is tossed a 100 times. It lands either heads or tails up.
How many times would you expect a head to show?

Translation: (IX) COIN ('F' handshape thumb and index finger form circle, other fingers straight – 'B' palm hand, fingers extended and together) on other hand 'G' circle round on palm YOU TOSSED X 3 times HUNDRED (IX) YOU TOSSED HEAD – TOSSED TAIL (IX) YOU palm on right hand (hold information) TOSSED X twice (IX) YOU refer to hand palm HOW MANY YOU WRITE DOWN.

This question was not an easy one to think about translating, and needed to be expressed very clearly in BSL.

> We can point to locations in signing space that have been assigned to referents, but it is also grammatical just to look at the locations. ..... Eye gaze can also be used to follow movements traced by the hands. For example if locations for a ball

> and goal have been established in signing space, then the eyes follow the path of movement of the sign in (BALL)-FLY-THROUGH-THE-AIR-TO-GOAL. Sutton-Spence, R. & Woll, B. (1999:95).

The translation needed to show that the coin was tossed repeatedly, and eye gaze and head movement were used to emphasize the action of the tossing, in the same was as the eyes and head would follow a ball rolling from one place to another.

Year 6: The Questions:

Question: Think of a number. Double it. Half it. Take away the number you first thought of. What have you got now?

Translation: YOU THINK VISUALIZE NUMBER (IX - referring to the location of the 'vision') YOU DOUBLE (IX – referring back to the 'vision') THEN NUMBER (IX – referring to the location of the vision down to central location) TAKE AWAY ANSWER WHAT?

For this question, the sign VISUALIZE had to be added to the sentence to show a number being visualised in a location (near the head). The imaginary number in its location could then be 'moved' from the location near the head to the usual signing space in front of the body, so that it could be manipulated and changed, as in 'double it' and 'half it'. The original location could also be referred back to throughout the question, as in 'the number you first thought of'.

BSL translation of mathematical problems involving written English must also use visual space to represent the mathematical problem being translated.

The translation of this question shows the crucial importance of location and eye gaze.

"We can point to locations in signing space that have been assigned to referents, but it is also grammatical just to look at the locations. " Sutton-Spence, R. & Woll, B. (1999) p.95.

Using Sign Supported English or another sign system would make this question very difficult to understand, because SSE does not use space, location, referencing, and NMF. Signs are produced in a single space, in a linear fashion following English word order (in fact, some people who use SSE use their voices to speak the words as they sign them).

Locations and eye-gaze must be carefully thought about in a translation, as well as the meaning. The sign THINK would not be used; rather it should be replaced with the sign that denotes IMAGINE/VISUALISE. This would be signed in a location near the head and to one side. Then in that same location, the sign DOUBLE would be given. Then the location would be moved down and towards the centre of the signing space, and the sign HALF given. For the sign TAKE AWAY, the location would shift down and across again. Then in the final location (at a point on a diagonal below the original location), ANSWER WHAT would be signed. The eye gaze would have followed the hands in each location. This gives the parts of the question a logical sequence that is clear in BSL.

The question in written English uses the pronoun 'it' twice and takes its reference (an anaphoric relationship) from the preceding phrase. "Think of a number'. Fluent users of English have learnt this rule and use their knowledge of it unconsciously. The translation in BSL uses eye gaze and the 'pointing' pronoun to index and relocate the original number from its top left to a neutral space where the mathematical operations may be posed ("Double it, Half it,'). Fluent users of BSL have learnt this rule and use their knowledge of it unconsciously. For both fluent users of English and fluent users of BSL a highly developed, unconscious (intuitive) knowledge of the language is required to be able to

perform the maths. (From the most recent analysis of the Y6 assessment, 71% of children – using English – gave a correct answer to this question. It has a discrimination of 0.63).

One question is: what number of signing pupils would think about placing numbers in the signing space? Would they do this in their own performance of signing about maths and number? The location has to be changed for the different parts of the question - 'Double it. (move location) Half it." - and the eyes follow the hands as they move diagonally downwards. A classifier is used to show "take away the number you first thought of" (the classifier for the original number moves from the first location to the last). There are complicated links here between syntactic and topographical signing space.

Question: Which number is 5 times as big as 30?

Translation: 30 (IX- refer space) 5 X BIG (NMF puffed cheeks for big) YOU ANSWER.

In BSL the cheeks are used to provide non-manual emphasis for signs to do with size. In this translation, the sign BIG has the NMF of puffed cheeks. Likewise, the sign SMALL or if something small in size is being talked about, the cheeks would be sucked inwards. This is the same for thin or narrow.

> Oral components which serve as adverbs can be added to give extra information about the manner or effort of an action. (An adverb is any part of speech that tells us more about an action). The same oral components are used to show the extent or size of an object or the degree (e.g.) 'bigger', 'biggest') of an adjective. These are basically the same components, although the meaning of manner or size depends on what is being modified. For example, if an action is performed with no special effort, the oral component 'relaxed mm' is used. The same oral component

is used when describing an object as being of average size. Sutton Spence, R. & Woll. B. (1999) p 86 The Linguistics of British Sign Language.

Question: Write the number eighty two thousand and three point five.

Translation: YOU WRITE EIGHTY-TWO THOUSAND AND THREE POINT FIVE.

This translation raises the issue of the order of signs when signing a number.

Teachers working in Leeds advised the translation team about how deaf pupils conceptualise numbers such as 'thousands'. On their advice the sign THOUSAND was chosen for this question, rather than signing each numeral (EIGHT ZERO ZERO ZERO) which is also a commonly used way of signing thousands in BSL. It is more comprehensible for pupils when numbers are signed which include names for multiples of ten. This is how numbers are signed in the adult Deaf community – rather than e.g. 802003 as a series of separate numbers, as in a telephone number. This latter way of signing would parallel someone speaking a series of separate numbers rather than one number.

Question: What is the perimeter of this shape?

Translation: SEE (IX English word on screen 'perimeter' - points to the word) WHAT?

Question: Which day had the hottest afternoon?

Translation: AFTERNOON HOT (non-manual features) WHICH?

As with 'biggest', 'smallest' and so on, 'hottest' had to be dealt with carefully. It would have been correct in BSL to sign 'WORST HOT WHICH?' but the translation team wanted to avoid using WORST for this DVD, to avoid confusion from teachers who many not be

native BSL users, and pupils who may not be used to seeing fluent BSL in use (e.g. those with no Deaf adult role models working in their schools). For this question, it was possible to convey the concept of 'hottest' by manipulating the sign HOT (signing it slowly and with more exaggeration than usual) and using a dramatic non-manual feature to emphasise extreme heat. This technique would also have worked well for a question about 'coldest'.

Question: What is the temperature on this thermometer?
Translation: THERMOMETER TEMPERATURE WHICH (IX)?

SASSs are classifiers, which tell us something about the physical features of objects, specifically their size and shape. Brennan, M. The Visual World of BSL. (1992) p 47.

The sign THERMOMETER is articulated with the forefinger moving from the mouth and then being shaken as one would a thermometer. This is a case of a part of the hand actually 'becoming' the object, and is useful for this question, because the sign TEMPERATURE can then be signed right onto the same finger (which is still the 'thermometer'). TEMPERATURE is signed with the other index finger moving up and down the 'thermometer'.

> Classifiers are expressed in BSL by means of the handshape. It is the handshape, which tells us which class a referent belongs to: whether is round, flat, long and thin, human, a vehicle and so on. However, the situation is rather complex. This is both because then same handshape can express different types of classifier meaning, and because a specific category may be expressed by more than one classifying handshape: the B handshape can function as a size and shape classifier, a handling classifier, an instrumental classifier and touch classifier. Brennan, M. The Visual World of BSL. (1992) p 46.

I would call the handshape of the index finger, used after it has been used for the sign THERMOMETER, a 'proform'. This is because it is a similar size and shape to a real thermometer. The same thing could be done in BSL with 'pen' – the sign PEN could be given, and then the index finger could 'become' the pen, and perform the action of 'writing'.

> The maths of the Year 2, 4 and 6 assessments are of course intended as an assessment of mathematical skills and knowledge in general. However, none of the Maths Year 6 questions are written only in mathematical symbols: they assess mathematical skills and knowledge by assuming a particular level of fluency in understanding written English and knowledge of English vocabulary. Additionally, some questions call for knowledge of a particular English vocabulary item to be able to answer them correctly. None of the questions require grammatical knowledge of English to demonstrate the correct answer: answers are by either ticks in a box or writing numbers. Collins, Tate & Tymms. Deaf Worlds Vol 19 (2003) p.17.

It is important that deaf children are able to receive the assessment questions in BSL, their first language, and when they understand the questions they can answer them by either ticking a box or writing down a number. This BSL DVD is essential in providing equal access for deaf pupils to assessments.

> Deaf children in bilingual education are dealing not only with sign language and spoken-language input but also with written language, fingerspellings, and signed variants of the oral/written language. (Plaza Pust To the Lexicon and Beyond, 2004:153).

It is not difficult for deaf children to acquire signed variants, and they would ask for a repeat if they have misunderstood something. The teacher of the deaf or the Deaf instructor working with them can also adapt the signs to the variants occurring in the region the child lives in.

> Gregory's discussion does identify a specific difficulty that might be faced by deaf children who rely on BSL: there is no standardized mathematical vocabulary in BSL and the children might encounter different signs for the same mathematical ideas if they change schools. This is not a trivial issue, but I cannot account for the difference between deaf pupils who are educated orally and their hearing counterparts. Nunes, T. Teaching Mathematics to Deaf children. (2004) p153.

There is no standardized mathematical vocabulary in BSL, and we tried to reflect this in the DVD, because most Deaf people in different regions use their own signed variations. I have discussed this further in other chapters, particularly in relation to different handshapes for numbers.

Summary

This paper represents a rare insight into the issues surrounding translation from English to BSL with specific reference to assessment of mathematics for deaf children. It was developed through native cultural and linguistic knowledge from Deaf teachers including my own and related to theoretical understanding: Deaf expertise. The questions presented in this chapter illustrate the importance of careful consideration of which sign vocabulary to use and grammatical constructions for both numbers and mathematical concepts. Additionally, when to use appropriately finger-spelling rather than other sign vocabulary. Previous research by non-native researchers has neglected these concerns, and

focussed on issues to do with spoken English and sound – to the detriment of deaf children learning through sign language. This paper builds on previously published research into translation appropriateness by Collins, Tate and Tymms (2003) to provide a more in-depth analysis of what is involved in translations such as these. This will be useful to Teachers of the Deaf who use translations of English questions in their teaching and assessing of deaf children. Translations of assessments such as these are the first step in the improvement of Deaf education, and discussion of the details of the translation process in this paper show how successfully questions can be translated for deaf children for whom BSL is a first and preferred language.

This research is not about experiments. It is about the real life challenge of finding effective translations of real questions so that deaf children can benefit from having equal access to assessments during their education.

Conclusion

The preceding chapters have examined the use of sign language in mathematics assessments. Relevant research has been reviewed, and a common thread has been drawn out: important points have been missed in the current literature because researchers are hearing second language users of BSL, thus they fail to pick up on some of the subtleties employed by native signing children.

More research is required to fully understand the use of sign language in mathematics, and the participants and researchers should both be Deaf. Many studies have looked at deafness as a 'hearing loss' or labelled it a 'hearing impairment', and have examined situations where the teaching method used is an oral method. It is with sadness that I must note that deaf children in education could have more skills in mathematics had their hearing teachers and the researchers assessing their skills known more about how to judge their skills in sign language. If, in the future, teachers and researchers can have a native understanding of BSL, deaf children's understanding of mathematics will greatly improve, and their sign language will be able to develop the correct linguistic features. I believe that many of the problems are that there are many learning situations which researchers have to experience to be able to work with deaf children on a deeper level. I hope that researchers will be better able to reflect on and interpret their experience, leading to a more positive result. Hearing culture is the dominant one – the funding, dissemination and supervision may well be largely hearing. This leads to an immediate imbalance in any research. The hearing researcher may well spend a great deal of time as the only hearing person among Deaf people. It is everyday Deaf people who are missed and not included in their work, and it is precisely these people who can bring huge benefits, insight and understanding to the research.

This is the historical legacy that follows hearing people who attempt to do research with deaf children.

Within British Sign Language, standardised signs for many mathematical concepts do not currently exist. If we are thinking of developing signs for mathematical words, signs should be developed by Deaf people, and should be related to the processes they represent. This is an important issue, as it relates to deaf children's access to mathematical words and concepts, and to assessment. Within the translations, knowledge of an English word was tested by asking the child to read either the written version or a fingerspelled version of the word. Thus English words were kept in the translations. Conversely, for a question assessing knowledge that could be expressed in any language, once translated, was rendered in a visual language. Also, it was important for schools to be able to insert their local / regional vocabulary. I have shown examples of these translations from English to BSL using mathematical vocabulary in this paper.

Throughout the chapters the need for further research was emphasized. I have a great fear that the work of hearing researchers is being published, read, and respected, and yet contains glaring omissions when looking at deaf children who use BSL. I have given a plethora of examples of how hearing, second language users of BSL often do not see everything a deaf child signs, and so cannot accurately assess their levels of understanding. I have also shown how to translate from English into BSL in assessments. There has been a lack of recognition that the researchers are as much a part of the dominant culture as the teachers themselves, who are also being indirectly studied. The results of such research simply highlight how the usual research methodology is not useful for examining deaf children's achievements, because it does not incorporate a detailed look at children's use of BSL from the perspective of those with specialist knowledge of the language, or at the interaction of the researcher and the staff and deaf

children, or the lack of involvement of Deaf adults and Deaf professionals. The research raises more questions than it answers.

I also found that, while some of the published research addresses sign vocabulary as it relates to mathematics, there is a lack of discussion of other linguistic features of sign language. This is an area I would hope to be able to examine in future research.

The examples I have given of my own personal story of working with deaf children and their teachers, which I enjoyed very much, and of the development of an assessment programme accessible to deaf pupils, provide a glimmer of hope for the future, a future that would be enhanced by the development of a nationally used BSL curriculum from the point of entry to compulsory education.

With work such as this, and with Deaf adults working alongside hearing teachers, success in mathematics *can* be achieved by many more deaf children. I hope this research will make it possible for more teachers and children to benefit from a mathematics programme that includes the use of sign language as a fundamental too.

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